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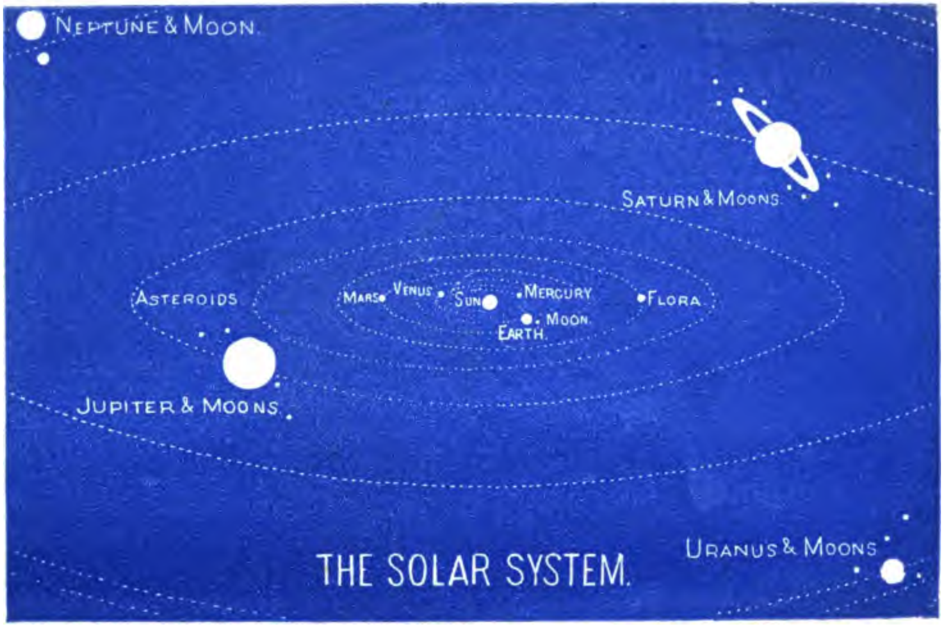
NIGHTLY WANDERINGS IN THE GARDENS OF THE SKY.



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NIGHTLY WANDERINGS

IN THE

GARDENS OF THE SKY.

By JAMES NICHOLSON,

AUTHOR OF "KILWUDDIE AND OTHER POEMS,"
"FATHER FERNIE," ETC.

BIBLIOTHECA
OCT 1881
BODLEIANA

Flowers of the midnight sky, how bright ye bloom,
God's own forget-me-nots, sweet clustering there,
Twinkling like heath-bells through the nightly gloom,
Blooming for ever in God's garden fair.
But to the eye of reason, when brought near,
The startled soul stands awe-struck at the sight;
Suns, systems, worlds, their glorious forms uprear,
O'erflowing with excess of life and light.

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DEDICATION.

To My

Brethren in Toil,

AND

SPECIALLY THOSE WHOSE SOULS ARE UNFOLDING

TO

APPREHEND THE MARVELLOUS PHENOMENA

OF THE

UNIVERSE.

PREFACE.

In publishing these papers in book form, my object is to do for Astronomy what I have endeavoured, in a humble way, to do for Botany, viz., to direct the attention of the more intelligent among working men to the attractions which the world of Nature presents to our notice, and the pure and elevated pleasures with which she rewards all who cross the threshold of her temple of wonders. That our little book—"Father Fernie"—was the means of leading not a few to become delighted students of the "gentle science," we have had the fullest evidence; and we are glad to think that to the lives of such it has added a new and never failing source of happiness. But as it is only during the comparatively short season of summer that such studies can be successfully prosecuted, our little work on the stars will open up a new and higher field of study to the thoughtful student through the dull and cheerless season of winter. Moreover, as the best season to begin the study of the stars is in the autumn, when the season of flowers is at an end, the student will pass at a bound, so to speak, from the contemplation of God's garden on earth to those grander conservatories of creative display in the heavens. And though he may not be able to replenish his vasculum with the treasures of those higher fields, he has the consolation of knowing that such flowers need not his poor services in the way of preserving and collecting, seeing that their blossoming is not for a day, but for ever.

In the query columns of a weekly paper, there appeared not long ago a communication from a working man desiring to know the name of an unusually bright star which he beheld in the morning as he repaired to his work; he had questioned his fellow workmen on the subject, but was only laughed at, and told not to trouble his brain about such matters. But nothing daunted by the rebuff, he now sought the coveted information by asking the editor if he knew of any work on the subject that would be suitable for a working man, and, at the same time, not too costly for his limited means. When I read this communication, the thought struck me that the Astronomical Papers I had written for the "People's Friend" would, if carefully revised and extended, form just such a cheap and useful work as the writer was in quest of.

No doubt those who know all about Astronomy may think such an effort uncalled for, yet I know there are far more who will be ready to welcome it as a messenger of good things. Meanwhile, I wish it to be distinctly understood, that in Astronomy I myself am but an amateur, my object, as already stated, being simply to present the observations and discoveries of others in such form as to attract and win working men like myself to such a glorious field of study. In so doing, I anticipate that not only will the reader find in the following pages much to interest and enlighten, but also that which will be the means of awakening in him a desire to peruse the works of the authors to whom I am so deeply indebted. Should this very desirable object be in some measure accomplished, believe me I shall feel that my humble efforts have not gone unrewarded, even though I should be at some pecuniary loss.

I would not advise the reader to begin the work of tracing the constellations before the time mentioned in Chapter I., viz., September, as he will then be better able to follow them in their courses from month to month during the year. He will also be greatly assisted in his efforts by the use of a good atlas of the stars. The one I would most heartily recommend is "Gall's Atlas of the Stars," which is a marvel of cheapness and utility, the price being only 1s. This, and "The Guide to the Constellations" by the same author, were of great service to myself, and I, therefore, the more heartily recommend both to all who would gain a comprehensive knowledge of the subject.

JAMES NICHOLSON.

Merryflats, Govan.

CONTENTS.

PAGE

CHAPTER I.—The Pole-star, its importance as a fixed point from which to trace the other Constellations of the Northern Heavens—How to find it—Charles' Wain, or *Ursa Major*, the Great Bear—*Ursa Minor*, or the Little Bear—Dual Motion of the Earth, ... 15

CHAPTER II.—Constellations of the Polar Circle—*Cassiopeia*—*Lyra*—*Draco*—*Auriga*—The Milky-Way—*Boötes* and the bright star *Arcturus*—*Corona Borealis*, or the Northern Crown, 22

CHAPTER III.—November—Altered Position of the Constellations—What may be seen from an attic window—The Cassiopeian Family: *Cepheus*, *Perseus*, *Andromeda* and *Pegasus*—*Algol*, or the Demon-star—The Double Star *Almach*—Greek names and mythology of the Stars borrowed from India—The Great Square of *Pegasus*—*Cetus*, the Whale—*Cygnus*, the Swan—Distance of nearest Star—How measured—61 Cygni—New Stars and their significance, ... 30

CHAPTER IV.—The Heavens in December—Constellations seen in the morning—Equatorial Stars and Constellations—The Signs of the Zodiac, their origin, division, and signification—Chinese names for Zodiacal Constellations—The Shepherds of Chaldea the first Astronomers—Scriptural allusions to the Constellations—Star-worship of the Ancients, ... 39

CHAPTER V.—Position of the Constellations in January—*Orion*—The Pleiades, their importance to the Ancients—The Pleiadic Year—The Pleiadic Festivals: Traces of in India and Egypt, among the Jews and ancient Druids, in Mexico, and Australia—The Great Central Sun of our Universe,... 48

CHAPTER VI.—February—Farther alterations in the positions of the Constellations—*Mira*, or the Wonderful Star—Appearance of *Leo* in the East—Re-appearance of *Arcturus*—Bernice's Hair *Cor Caroli*—Difference of Position of the Constellations at different hours: how caused—The Grand Star-picture of the Year—*Castor* and *Pollux*—*Sirius*, or the Dog-star; Historical Associations—The Great Nebula in the Sword of *Orion*—Other Universes—Dream of the German Poet, ... 56

CHAPTER VII.—The Constellations in March—The Astronomy of the Ancients—Supposed Solidity of the Celestial Vault—Sphere within Sphere—The Earth the Centre of the Universe—Alphonso, the Astronomer King, ... 64

PAGE

CHAPTER VIII.—The Constellations in April—Astronomy of the Ancients Continued—The System of Ptolemy—Copernicus and his System—Priestly attempt to alter the names of the Zodiacal Constellations, ... 70

CHAPTER IX.—The Position of the Constellations in May—Close of the Celestial Summer—Mystery of the Stellar Universe—Our own Solar System the Key to the Mystery—The Sun and his Family—Planetary Globes: their Origin and History—The Nebular Theory, ... 75

CHAPTER X.—More about the Sun—Sun-Spots, their Nature and Origin, extent, duration, and periodical increase and decrease—The Photosphere, its Chemical Constitution—Spectrum Analysis, ... 78

CHAPTER XI.—The Planet Earth: its Phenomena, Cosmical History, and Constitution, ... 85

CHAPTER XII.—The Moon: what the Telescope reveals concerning it—Absence of Water or Atmosphere—Its Phases and other Phenomena explained—Popular Fallacies concerning it, ... 88

CHAPTER XIII.—The Interior Planets: Mercury, Venus, and Mars—The Exterior Planets: Jupiter, Saturn, Uranus, and Neptune, 92

CHAPTER XIV.—What, then, are the Stars?—For what purpose do they shine?—Analogy the Key to the whole—Beauty and Harmony of the Universe—Old age and decay of our World—Probable return of the Earth and other Planets to the Sun—Is there a Spirit-World?—If so, where is it? 102

APPENDIX.—The Southern Constellations, ... 110
- Northern Constellations, ... 112
- Constellations of the Zodiac, ... 113
- Stars of First Magnitude, ... 113
- Distances of the nearest Stars, ... 114
- The Larger Planets, ... 114
- Comets, ... 115
- Meteors, Shooting Stars, Aeriolites, &c., ... 117

INDEX, ... 121

INTRODUCTION.

"Ye stars! bright legions that before all time
Camped on open plain of sapphire, what shall tell
Your burning myriads, but the eye of Him
Who bade through heaven your golden chariots wheel?
Yet who, earth-born, can see your hosts, nor feel
Immortal impulses—Eternity?
What wonder if the o'er-wrought soul should reel
With its own weight of thought, and the wild eye
See fate within your tracks of deepest glory lie?"
—*Croly.*

In this enlightened age of improved education, Mechanics' Institutions, Schools, and School Boards, it is surprising how little even persons of superior education know of some of the most familiar natural objects around and above them. Somewhere in his writings Thomas Carlyle speaks regretfully of the fact that in his younger years those who had charge of his education made no attempt to familiarise his mind with the names of such common objects as the wild flowers and the constellations. We ourselves, like many others, long felt the same deprivation, but having by stern necessity been taught the grand lesson of the almost infinite possibilities of self-endeavour, and mindful of the old proverb, that it is never too late to learn, at once resolutely set ourselves to the task. And having succeeded beyond our expectation, as well as greatly added to our stock of earthly enjoyment, we feel that even this would be greatly enhanced if by any means we could assist others in their efforts or aspirations to drink out of the same soul-refreshing well-springs. Having already, to the best of our ability, and with some little success, endeavoured to make our fellow-readers acquainted with our native wild flowers, we now propose to ourselves the perhaps more difficult yet none the less delightful task of helping them to a knowledge of

> "The stars which are the forget-me-nots of the angels."

The subject is one well fitted to interest the intelligent reader, while to the keenly observant student of Nature it is one that cannot fail to expand and elevate, filling his soul with feelings of wonder, admiration, and delight, deepening and strengthening his love and confidence in that Being who is the creator and upholder of all things. Where is the man who, in the calm stillness of an autumn or winter night, can look up to and contemplate the vast blue canopy of the heavens, as it glows and sparkles from horizon to zenith with stars sown broadcast and countless as daisies in May, without experiencing that profound sense of awe and mystery that comes, dove-like, descending out of the solemn stillness to take possession of his being and bend it in lowly adoration at the feet of the Great All-father? Filled with this over-powering sense of the infinite, he is ready to exclaim with the Hebrew poet-king, "What is man that thou art mindful of him; and the son of man that thou visitest him?" And yet, when we consider with what glorious faculties God has endowed the sons of men, and the marvellous progress we have made in acquiring a knowledge of these, the most wonderful and awe-inspiring of His works, we are constrained with the Psalmist to say, "Thou hast made him a little lower than the angels, and hast crowned him with glory and honour."

Notwithstanding all this, how few—even among pious and educated Christians—are at all familiar with the facts which science has revealed of those sublime mysteries. Strange to say, the uneducated shepherds of ancient Chaldea and Egypt, who lived thousands of years before the Christian era, were more familiar with the stars and the constellations than we of the 19th century, with all our boasted educational advantages. In the

Book of Job, supposed to be the oldest literary production extant, we find evidence that, both to the writer and to those for whom the book was written, some of the more conspicuous constellations were well known. Take, for example, the 9th chapter and 9th verse, where, speaking of the Creator and His wonderful works, he says—"Which maketh Arcturus, Orion, and Pleiades, and the chambers of the South." And again, in chapter xxxviii. 31—"Canst thou bind the sweet influences of Pleiades, or loose the bands of Orion? Canst thou bring forth Mazzaroth in his season? or canst thou guide Arcturus and his sons?" In both these passages the sacred poet makes reference to three of the most marked and universally known constellations or groups of stars. By "Arcturus and his sons" is evidently meant the well-known northern constellation *Ursa Major*, the Great Bear, and familiarly known to most people as the Plough, and perhaps including the constellation which follows immediately in its wake, *Boötes*, the Herdsman, also known as *Arctophylax*, the Bear-driver. Conspicuous by its splendid star *Arcturus*, the name is a combination of two Greek words, signifying "Bear" and "Tail." By the Pleiades is meant the well-known cluster called the Seven Sisters, or Seven Stars, which is in the constellation *Taurus*, or the Bull; while Orion is that magnificent group of stars which occupies such a prominent position in the southern heavens during our season of winter, and well-known to all by the oblique row of stars which form the belt or band of Orion, and bears the name of King's Ell-wand.

Astronomy may be thus said to be the oldest of all the sciences, its phenomena having been observed by mankind from the earliest ages. And the more so that the men of those early times were chiefly engaged in pastoral occupations. Hence they were obliged to be much out during the night season, in order to protect their flocks from the attacks of beasts of prey. In this way their midnight vigils would afford them excellent opportunities of observing celestial phenomena.

But besides this they were favoured by the clear atmosphere which prevails in those eastern lands, where the human race were then chiefly located. Those who have witnessed the spectacle presented by the midnight skies of eastern countries tell us that the impression made upon the mind is grand and awe-inspiring in the extreme. So that it is not to be wondered at that the ancients were led to worship the "host of heaven," believing the stars to be the ministers of the Gods, and the source of influences both good and evil.

Even the Hebrew race, notwithstanding their monotheistic belief, were not unfrequently tempted to join in this idolatrous worship. With David, the shepherd of Israel and poet no less, it was otherwise; he saw in the splendour of the midnight heavens the clearest evidence of the power and glory of the One Supreme Being he had been taught to worship, and exclaims—"The heavens declare the glory of God, and the firmament showeth his handiwork; day unto day uttereth speech, and night unto night showeth knowledge."

The ancients were also made the more familiar with the heavenly bodies, and their mutations, by the fact that they were dependent upon them for their division of time. Their days and years were measured by the sun, while their months were checked off by the moon; and, as we will show farther on, the stars were an index of the changing seasons, as well as compasses to guide them in their journeyings by sea and land. We more highly favoured moderns have our time measured for us by clocks and other mechanical contrivances, while the magnetic needle is our sure guide, whether by night or by day. But, on the other hand, we are so walled-in by the limitations of town-life, and that not only from the green fields and leafy lanes, but the glorious night-fields of the sky, that we are prone to forget all about the grandly beautiful phenomena of nature. Besides which, we are so intent on the accumulation of material wealth, or it may be, to earn the means of even a bare subsistence, that the marvellous phenomena of earth and heaven have ceased to have any charm for us. Consequently, but for our conservatism in matters theological, we would long ere this have become rank materialists in theory, even as the major portion of us are in practice.

Than the study of the facts of Astronomy, I know of nothing better fitted to correct and expand a man's ideas of the Almighty Creator of all things, and at the same time, check the exaggerated estimates we are so apt to form of ourselves. And if those ancient Chaldean shepherds were filled with religious awe and adoration while contemplating the glorious spectacle of the midnight sky, how much more reason have we to be inspired with thoughts and feelings of the highest and holiest description when given to the same midnight contemplation! To them those countless shining orbs were but so many twinkling lamps set in a firmament of solid crystal. But to us more highly favoured moderns it has been revealed that each of those glimmering points of light is really a sun, similar to our own, and a fountain of light and heat to countless planetary worlds dependent upon them. Again, we are told that the very nearest of those suns are separated from us by an interval of not less than 19 billions of miles; while other stars belonging to our system are so distant, that light, travelling at the rate of 185,000 miles in a second of time, would take at least 10,000 years to pass from them to us. One astronomer calculates that it would take 200,000 years to *count* even the number of miles to the nearest star. Farther away still are those nebulous clusters supposed to be universes in the course of formation, so distant, that light, travelling at the same inconceivable rate, could not reach us from them in less than 700,000 years.

But to speak of such immensities of time and space to those who know nothing of the subject, will, we fear, be like speaking in an unknown tongue, or as the telling of idle tales. We will, therefore, in order to make our readers familiar with the subject, begin at the beginning.

NIGHTLY WANDERINGS
IN THE
GARDENS OF THE SKY.

CHAPTER I.

The Pole-star, its importance as a fixed point from which to trace the other Constellations of the Northern Heavens—How to find it—Charles' Wain, or *Ursa Major*, the Great Bear—*Ursa Minor*, or the Little Bear—Dual Motion of the Earth.

In order to make the subject clear to our readers, and to ensure progress in attaining a knowledge of the same, I shall proceed on the understanding that all are alike ignorant of it. Even the most cursory glance at the midnight heavens will enable one to see that the stars are not uniformly sown over the sky, but that they are arranged in groups or constellations. These constellations are varied in their outline, while some of them bear more or less resemblance to terrestrial objects,—as, for example, *Ursa Major*, or the Great Bear; more commonly known as the "Plough," and so called from its supposed resemblance to that ancient implement of the agriculturist. It will also be observed that the various star groups or constellations do not remain stationary, but keep slowly moving from left to right, or more properly, from east to west. The Plough, for example, which now occupies a position in the west at, say, six P.M., will, by twelve, have passed round to the north; at six A.M. it will have its handle to the east; at twelve noon, if we could see it, the handle will be directed south; while by six P.M. it will be once more in the west, having traversed the whole circuit in the space of twenty-four hours—less four minutes. But though the constellations are thus continually on the move they still maintain their relative positions to each other; hence the ancients believed that the stars were fixed in a solid firmament which turned upon an axis, and in turning carried the stars along with it. From the fact that one particular star did not move out of its place, but remained steadfast while the others kept circling round it, they inferred that this star must be one of the pivots upon which the firmament turned, and hence the name of the Pole-star *(Polaris)*. To the ancients this particular star was of prime importance as a fixed point wherewith to guide them in navigation or in journeys by night—just as the mariner's compass is the guide of seafaring men of more modern times. To the student of the stars it is no less important and useful, inasmuch as it furnishes him with a fixed point in the heavens from which to estimate the distances and find the positions of the other constellations. To find and identify this star is at all times a very easy matter when we have got hold of the Plough.

Taking it for granted, then, that all our readers are familiar with this well-known constellation—while even those who are *not* will recognise it at once from the annexed figure *(Diagram I.)*, which is the position it occupies during the present month (September). To find the Pole-star we have only to draw a line continuous with the two pointers of the Plough (that is, the two stars to the right), and at the distance of 29 degrees, or six times the distance separating the two pointers, we reach the star *Polaris*, or Pole-star. The Plough being low down in the north-west, our line, as a matter of course, will have to be drawn in an upward direction, that is, in the direction of the zenith, or point overhead. *Polaris* is the principal star in *Ursa Minor*, or the Little Bear; it is of the same magnitude as the stars which form the Plough. In the other stars belonging to it, though of less magnitude, it is not difficult to trace the form of the Plough, though on a smaller scale.

Polaris forms the tip of the Little Bear's tail, and being all but fixed, the stars belonging to it seem as if revolving around it, something after the fashion of a dog in pursuit of its own tail. Now, in order to understand thoroughly the importance of this star, as a fixed point in the heavens, and why it comes to be fixed, or seems to be so, let us suppose that the blue dome of the sky over our heads is a colossal umbrella, with a

PLOUGH
POLE STAR

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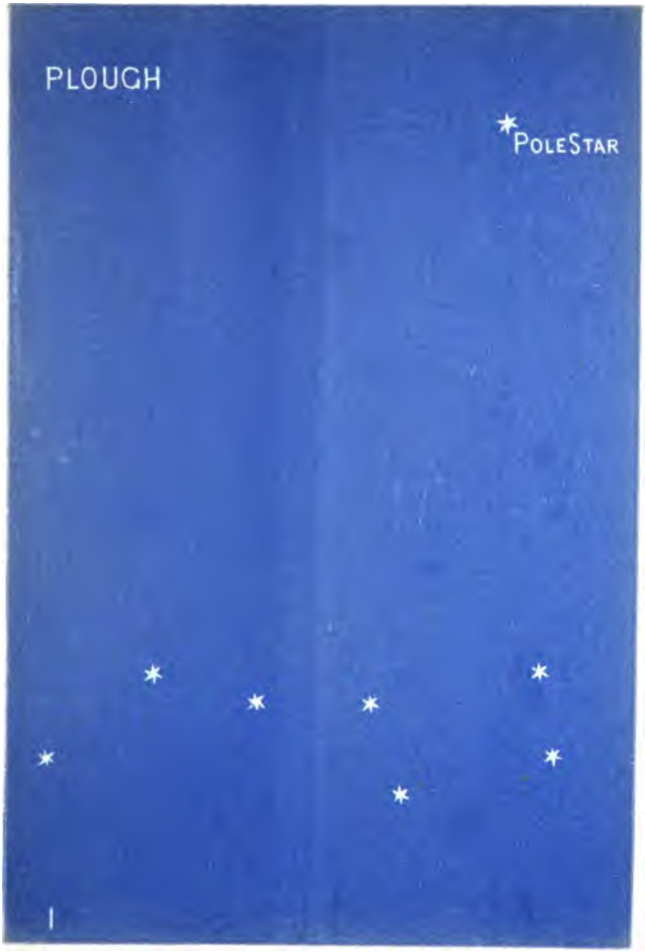
PLOUGH
POLE STAR
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staff or stem reaching from the spot we occupy to the Pole-star. Having hold of the handle, suppose we turn it slowly round; by the time it has performed one-half of a revolution, the Plough will be just as far on the other side of the Pole-star, and consequently to the south of it, as well as much nearer to the point over our heads called the zenith. In like manner the other constellations, which extend in all directions, from the Pole-star to the horizon, will have gone round to the opposite side to that from which they started; while on completing one whole revolution of our great umbrella, each of the constellations which ornament its blue expanse will be found in the positions from which they set out. Now, this is exactly the phenomenon presented to our senses as we watch the course of the stars from evening until morning through a long winter night. We find that in the course of twenty-four hours the whole firmament, with all its glittering galaxies, has accomplished a little more than one complete revolution. Of this "little more" we shall have something to say by and by. Meantime, suppose that we detach the stem of the umbrella from the frame—still keeping it in the same position—and stick the lower end into the earth; or supposing it long enough to pass right through the earth, it would thus occupy the place of the imaginary axis or spindle upon which the earth revolves, while our great sky-umbrella, with all its stars, from which it has been detached, will be standing still. Suppose this, and you have the reality clearly presented to your mind; for it is the earth that revolves once in the twenty-four hours, and not the firmament. Just as when we are in a steamboat, or railway train, houses, trees, hedges, appear to the eye as if racing past, while in reality we know that it is the train or boat that is moving.

We have said that the firmament makes a little more than one complete revolution in twenty-four hours, the which little was very puzzling to astronomers till the grand discovery was made that the earth, besides its daily revolutions, performs annually a circuit round the sun, so that each night we see the stars from a position in space a little in advance from that from which we saw them on the previous night. We might not inaptly illustrate this by an equestrian in the circus, who never sees an object in the distance—say, a steeple or a flag-staff—from the same point of view, from the fact that his horse, in its progress round the ring, is continually altering his position.

This, then, will explain why the constellations seem to be moving, night after night, to the west; also, why the Plough, which just now occupies a position in the north-west, with the handle inclining toward the south, will in three months hence, at the same hour, be climbing from the northern horizon toward the zenith, with the handle hanging downwards; while in six months more it will be on the opposite side of the Pole-star, with the handle turned upwards—so that at the end of twelve months it will have travelled round the polar circle, and be found in the exact position it occupies now, while all the other constellations will have done the same. Only those constellations which occupy the space within a given radius of the Pole-star are visible to us during the entire year. Those more to the south disappear from our horizon by setting in the west, and make their appearance again, after a time, in the east. It will thus be seen that the earth, besides performing one complete revolution on its axis in 24 hours, also accomplishes at the same time one 365th part of its annual revolution round the sun; and in order to ascertain the amount of space traversed by our orb in a single day, we have only to consider the extent of its orbit—viz., somewhere about 570,000,000 miles.

Well, now that we have found in the star *Polaris* a fixed point from which to make our observations of the starry host, and from which to set out on our proposed wanderings, let us not, as is usually done by men elated with success, kick away the ladder by which we have reached our exalted position, but rather look back with wonder and admiration on those starry steps by which we have ascended. And this leads us in the first place to note more particularly the constellation *Ursa Major*, or the Great Bear, seeing it is the stair by which we have climbed to this all-important point in the northern heavens. We think that there can be no doubt but that it received its astronomical name from some fancied resemblance to a bear, the three stars which form the handle of the Plough being the tail, the other four the body, while the other smaller stars go to form the head and paws, as in *Diagram II.*

One author says:—"The constellation has no resemblance whatever to the animal after which it is designated, but the bear was probably elevated to the polar sky as an inhabitant specially of northern regions. The Iraquois, a tribe of North American Indians, were found, upon discovery of that continent, designating this part of the heavens, like the earliest Arabs of

GREAT BEAR. 11

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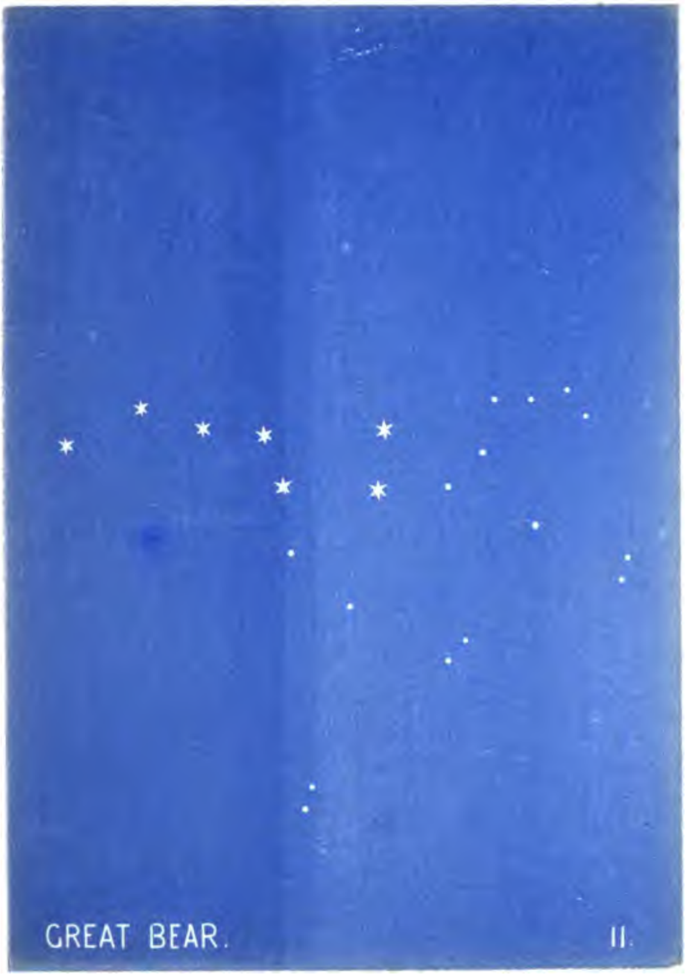
[illegible] that at the end of twelve months it
[illegible] polar circle, and be found in the
[illegible] while all the other constellations
[illegible] the same. Only those constellations which occupy
[illegible] in a given radius of the Pole-star are visible to us
[illegible] those more to the south disappear
[illegible] setting in the west, and make their
[illegible] in the east. It will thus be seen
[illegible] performing one complete revolution on its
[illegible] also accomplishes at the same time one 365th
[illegible] revolution round the sun; and in order to
[illegible] space traversed by our orb in a single
[illegible] only to consider the extent of its orbit--viz.,
[illegible] 570,000,[illegible] miles.

[illegible] we have found in the star *Polaris* a fixed
[illegible] our observations of the starry
[illegible] set out on our proposed wanderings,
[illegible] done by men elated with success, look
[illegible] we have reached our exalted position.
[illegible] with wonder and admiration on those
[illegible] we have ascended. And this leads us in
[illegible] particularly the constellation *Ursa*
[illegible] Bear, [illegible] it is the stair by which
[illegible] this important point in the northern
[illegible] that there can be no doubt but that it
[illegible] name from some fancied resemblance
[illegible] stars which form the handle of the Plough
[illegible] the body, while the other smaller
[illegible] and paws, as in *Diagram II.*

[illegible] the constellation has no resemblance
[illegible] which it is designated, but the
[illegible] to the polar sky as an inhabitant
[illegible]. The Iroquois, a tribe of North
Am[illegible] and, upon discovery of that continent,
desig[illegible] heavens, like the earliest Arabs of


GREAT BEAR.
II.

Asia, by a term signifying the Bear." Before the invention of the telescope, thirty-five stars could be seen by the naked eye in this constellation; since then between three and four hundred have been revealed by that instrument. The most prominent are the seven bright stars which form the Plough. The upper of the two pointers is named *Dubhe*; the lower, *Merak*; the next two to the left are *Megrez*—upper; and *Phad*—lower. The remaining three, forming the handle, are—beginning with that nearest to the quadrangle—*Alioth*, *Mizar*, and *Benetnach*. The middle star, *Mizar*, has a minute companion, almost touching it, called *Alcor*, and "Jack by the middle horse." The Arabs term it *Saidak*, signifying "trial," or "test," owing to their use of it as a test of the goodness of the eyes. Seen through the telescope, the two are a considerable distance apart from each other, while the larger star is found to be double—that is, having a small companion revolving round it. By the old shepherds the constellation was known as the Dipper or Ladle. In this homely but more apt illustration, the three stars are regarded as forming the handle, and the other four the bowl, of the utensil. Among the ancient Gauls it was known as "Arthur's Chariot." In France it is "David's Chariot," and in England it goes by the name of "Charles' Wain," a corruption of the Gothic *Karl Wogen*, the churl's cart. It is by one of these ancient names that Sir Walter Scott designates it in his "Lay of the Last Minstrel":—

> "Arthur's slow wain his course doth roll
> In utter darkness round the pole,
> The Northern Bear lowers black and grim,
> Orion's studded belt is dim."

By the "Northern Bear" Sir Walter evidently means the Little Bear, *Ursa Minor*, which is the central constellation of the northern sphere. In England, also, the larger constellation is familiarly known as the "Plough," and as such it was also known to the Latins *(Plaustrum)*, and the three stars of the curve were three oxen, from whence it would seem that they extended the idea to all the seven, and at last called them the *Seven* Oxen, *Septem triones*, hence the name sometimes used for the north—Septemtrional. Its other Latin name, *Ursa*, is thought to be derived from *versus*, to turn, because the constellation is seen to turn about the Pole. It has also been called the Screw, or *Helix*, which has reference to the same thing.

Another name is *Calisto,* in reference to its beauty, who, according to ancient mythology, was by the rage of Juno turned or transformed, along with her son, into bears, and made to travel endlessly round the North Pole. Lastly, the Great and Little Bears were known among the Arabs as the Great and Little Coffins, in reference to their slow and solemn motion. These names referred to the four stars forming the square of each constellation, the other three being the mourners following the bearers. The Christian Arabs made it the grave of Lazarus, and the three weepers, Martha, Mary, and her maid. In olden times, when clocks and watches were less common, this well-known constellation seems to have served the purpose of a time indicator; this was effected by noting the position of the two pointers, whether they were vertical or horizontal to the Pole-star, hence the remark of the carrier in Shakspeare—

> "An't be four by the day; Charles' Wain is over the chimney, and yet our horse not packed."

It was also, along with the Little Bear, of no little service to travellers, as well as to mariners, in the olden times. Diodorus Siculus states that in the sandy deserts of Arabia travellers were accustomed to direct their course by the Northern Bear; and the Koran recognises the same fact in this passage, "God has given you the stars to be guides in the dark, both by land and sea." It would appear that the Little Bear was either unknown to, or unheeded by, the earlier Greeks, seeing that Homer omits it in mentioning some of the other well-known constellations, as when he says, "The Bear, which alone does not bathe in the ocean;" in other words, which never sinks below the horizon. It is thought the Phœnicians were the first to recognise and take advantage of the Little Bear as a guide in navigating their ships, and hence their early superiority as a maritime nation. As we have already said, the chief star in this constellation is *Polaris,* or the Pole-star. By the astronomers of Arabia it was called *Alruccobah,* being the last and most conspicuous star in the Little Bear.

To the inhabitants of Lapland it is more elevated, and consequently nearer to the zenith than with us, while to the people of France it is less so, that is, lower in the horizon. To the people of Barbary, which is still farther to the south, it is lower still, while still farther south it is never seen above the horizon. To those leaving for countries on the other side of the equator, its gradual sinking out of sight is calculated to fill the heart with feelings of sadness and regret. In the last poem written by "L. E. L." (Letitia Elizabeth Landor) this feeling is very beautifully expressed:—

"A star has left the kindling sky,
A lovely northern light;
How many planets are on high
But that has left the night.

"I miss its bright familiar face,
It was a friend to me;
Associate with my native place,
And those beyond the sea.

"It rose upon the English sky,
Shone o'er our English land,
And brought back many a loving eye,
And many a gentle hand.

"It seemed to answer to my thought,
It called the past to mind,
And with its welcome presence brought
All I had left behind.

"The voyage it lights no longer, ends
Soon on a foreign shore;
How can I but recall the friends
That I may see no more.

. . . .

"But thou hast sunk upon the wave,
Thy radiant place unknown;
I seem to stand beside a grave,
And stand by it alone."

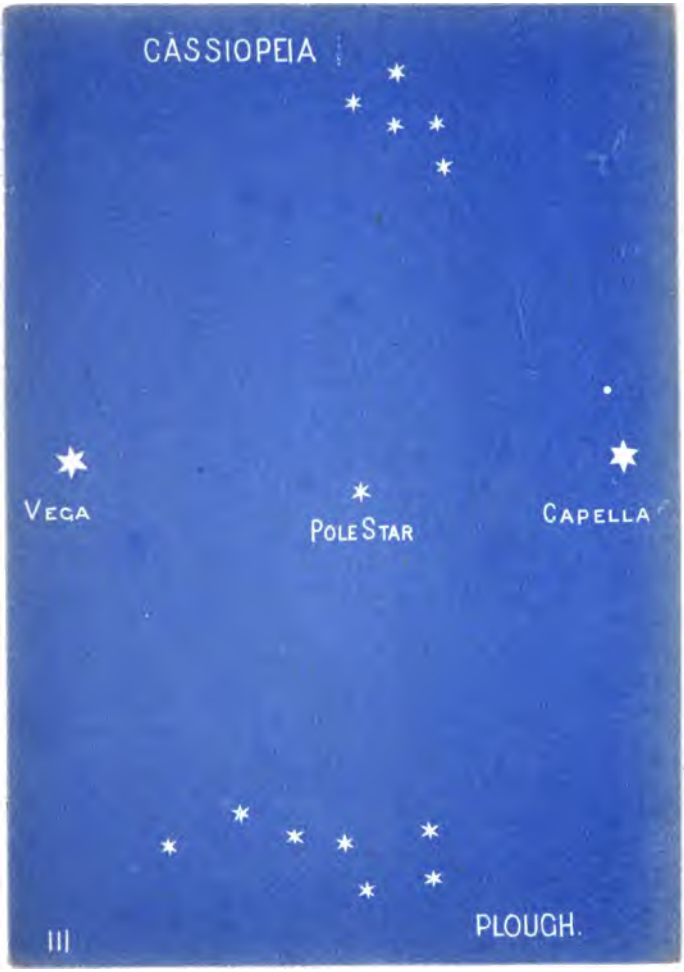
The last verse is rendered the more sad and significant from the fact that the gifted poetess had only been in her new home at Cape Coast Castle—of which her husband was Governor—two short months, when she was found lying dead upon her bed, having, either by accident or design, partaken of prussic acid.

From certain allusions in ancient authors, it would seem that the star *Polaris* did not at one time occupy a position so near to the polar centre. One ancient Greek writer speaks of a time when the most brilliant star in the neighbourhood of the Pole was α—that is, No. 1—of the Dragon. This was more than three thousand years ago. At that time *Polaris* was the most southern star in the Little Bear. One author, in speaking of this phenomenon, says:—"If we could alight upon documents dating back fourteen thousand years ago, we should find the star Vega (*α Lyra*) referred to as occupying the pole of the world." But these two constellations—viz., *Draco*, the Dragon, and *Lyra*, the Harp—we must reserve for our next chapter.

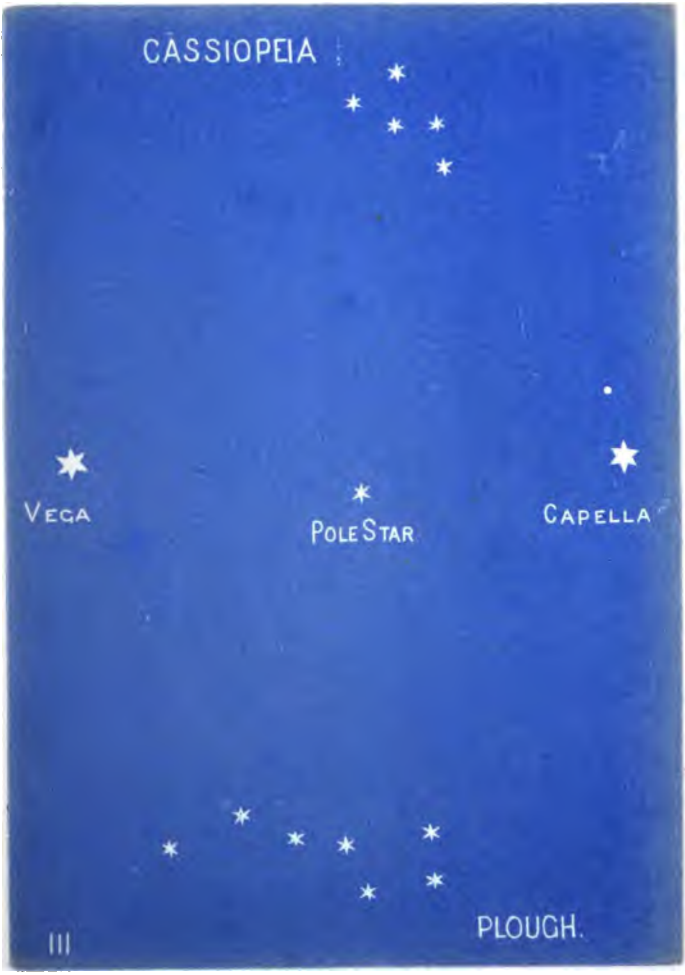
CHAPTER II.

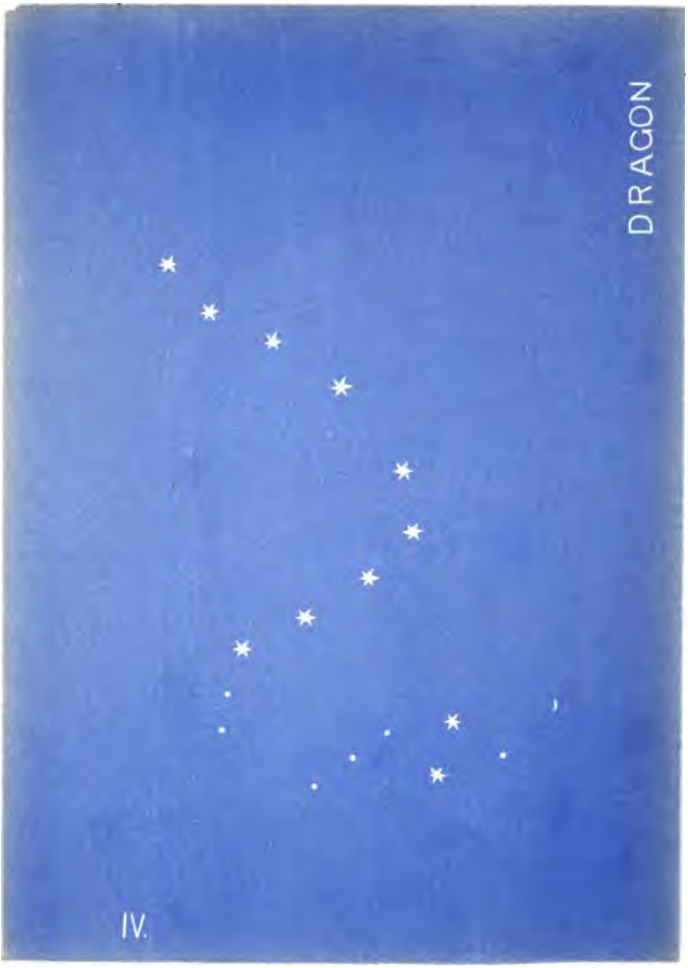
Constellations of the Polar Circle—*Cassiopeia*—*Lyra*—*Draco*—*Auriga*—The Milky-Way—*Boötes* and the bright star *Arcturus*—*Corona Borealis*, or the Northern Crown.

HAVING now ascertained the position of the Pole-star, or pivot, round which all the other constellations in our hemisphere revolve, and having furthermore learned something of that most marked, and no less familiarly-known of all the northern constellations, the Great Bear or *Ursa Major*, we are now in a position to extend our researches to those other groups that lie immediately beyond the Polar centre. Taking, therefore, our stand once more facing the Plough and following the line of the two pointers to the Pole-star, then to about an equal distance beyond it, we arrive at the well-defined constellation of *Cassiopeia*, or the Lady in the Chair. At all seasons and in all circumstances it occupies a position on the opposite side of the Pole-star from *Ursa Major*, and at about an equal distance. It is easily recognised by its five principal stars taking the form of a W. On this account it has also been thought to resemble an old-fashioned chair or stool of the "Jenny Geddes" pattern, or what is more familiarly known to us as a camp stool. The top or open part of the double-u is invariably turned in the direction of the Pole-star and *Ursa Major*. To the right of the Pole-star, and about midway between *Cassiopeia* and the Great Bear, in its halo of splendour, we also behold the magnificent *Capella*, a star of the first magnitude, accompanied by its companion star of lesser magnitude, *Menkalina*. They are the two principal stars in the constellation *Auriga*, or the Waggoner, *alias* the Coachman, or Charioteer; in other words, the leader or driver of Charles' Wain. Immediately opposite, and on the left of the Pole-star, at about the same distance


CASSIOPEIA
VEGA
POLE STAR
CAPELLA
PLOUGH.
III

[illegible] constellation [illegible]. At all seasons an [illegible] position on the opposite [illegible] and at those are [illegible] its [illegible] stars taking the [illegible] it has also been thought to resemble [illegible] stool of the "Jenny Geddes" pattern [illegible] is known to us as a camp stool. [illegible] is invariably turned [illegible] To the right [illegible] midway between *Cassiopeia* and the [illegible] of splendour we [illegible] behold the [illegible] star of the first magnitude, accompanied [illegible] of lesser magnitude, *Menkalina*. They [illegible] stars in the constellation *Auriga*, or the [illegible] Coachman, or Charioteer; in other words, [illegible] Charles' Wain. Immediately opposite, [illegible] the Pole-star, at about the same distance


CASSIOPEIA
VEGA
POLE STAR
CAPELLA
III
PLOUGH.



IV.

[illegible] are confirmed [illegible] in [illegible] side, [illegible] it is situated about [illegible] Ursa [illegible] left of [illegible] constellations [illegible] to occur [illegible] surrounding [illegible] a four [illegible] stellar region [illegible] small [illegible] by these, we [illegible] movement in her [illegible] in relation to these [illegible] reason the [illegible] ram, which in six months [illegible] which is occupied by [illegible] will be on the right [illegible]

[illegible] the radius formed by the [illegible] the three others of lesser [illegible] distinct [illegible] Camelopardus [illegible] Dragon [illegible] Cepheus [illegible] Pole [illegible] Cassiopeia, but the stars [illegible] magnitude are not easily [illegible] account they were [illegible] under the general term of [illegible] Draco; [illegible] a long [illegible] neck [illegible] from the Little Bear, of which constellation, [illegible] we have already said, the Dragon is [illegible] one quarter [illegible] The head of the Dragon is [illegible] the direction of Lyra, while the end of the tail [illegible] almost [illegible] the [illegible] the two pointers of the Plough. [illegible] the principal of the [illegible] stars forming the head is that nearest to Lyra. It was by observation of a star in this constellation that Hooke and Bradley were led to the discovery of the aberration of light. According to Greek mythology the Dragon was taken up to heaven and [illegible] into a constellation [illegible] faithfulness in guarding the golden apples of the Hesperides. [illegible] occupies a position between [illegible] Ursa Minor and Cassiopeia, but like Camelopardus [illegible] owing to the smallness of its [illegible] on globes and the starry sphere this constellation [illegible]

from the latter, we are confronted with *Vega*, another splendid star of the first magnitude, and chief of the constellation *Lyra*, or the Harp. It is situated about midway betwixt *Cassiopeia* and *Ursa Major*, on the left of the diagram. (See *Dia. III.*)

These four constellations, so conspicuous in their appearance, and so placed as to occupy the four quarters of the radius immediately surrounding the polar centre, may therefore be looked upon as four separate gateways opening out upon the boundless stellar region beyond; on which account they will be of no small service to us in our explorations. But in order to profit by these, we must not forget the fact of the earth's continual movement in her orbit round the sun, so that our position in relation to these constellations is continually altering. For this reason the Great Bear, which is now at the bottom of the diagram, will in six months hence be at the top, while his place will be occupied by *Cassiopeia;* and, following suit, *Vega* will be on the right, and *Capella* on the left of the diagram. Within the radius formed by these four well-marked constellations lie three others of lesser note, on account of their being less distinct—namely, *Cameleopardus*, the Cameleopard, *Draco* the Dragon, and *Cepheus*. The first of these lies betwixt the Pole-star and *Capella*, but the stars of which it is composed being of small magnitude, are not easily traced by the unassisted eye. On this account they were left out altogether by the ancients under the general term of *unformed* stars. *Draco*, the Dragon *(Dia. IV.)*, is a long, straggling constellation, its lower curves hanging in a festoon, and in certain positions depending like a necklace from the Little Bear, of which constellation, as we have already said, the Pole-star is the chief, and situated at the tip of the tail. The head of the Dragon is bent round in the direction of *Vega*, while the end of the tail is almost in a line with, and close to, the two pointers of the Plough. *Etanim*, the principal of the four stars forming the head, is that nearest to *Vega*. It was by observation of a star in this constellation that Stoke and Bradley were led to the discovery of the aberration of light. According to Greek mythology the Dragon was taken up to heaven and changed into a constellation on account of his faithfulness in guarding the golden apples in the garden of the Hesperides. *Cepheus* occupies a position betwixt the head of *Draco* and *Cassiopeia*, but, like *Cameleopardus*, is not easily made out owing to the smallness of its component stars. On globes and the starry sphere this constellation is represented in the form of a king.. In mythological history he is the king of Ethiopia, and husband of Cassiopeia.

Having now learned the precise positions of the four most conspicuous of the Northern constellations—*Ursa Major*, *Cassiopeia*, *Lyra*, and *Auriga*, let us now proceed to mention a few particulars concerning the three last named, as we have done of the first, in the preceding chapter; the which particulars will, we have no doubt, considerably add to their interest in the estimation of the non-scientific reader.

The constellation *Cassiopeia* derives its name from Cassiopeia, queen of Ethiopia, who, according to mythology, was the wife of Cepheus, and the mother of Andromeda, the beautiful princess, who boasted that she was fairer than the Nereids or Nymphs, and so aroused the wrath of the latter that they besought Neptune to revenge the affront; this he did by sending a great sea-monster into the country, which caused great havoc. To appease the wrath of the god, Cassiopeia consented to expose her beautiful daughter to the tender mercies of the monster. For this purpose she was chained to a rock, but very fortunately she was rescued just in the nick of time by the valiant Perseus, who slew the monster, and obtained of Jupiter that Queen Cassiopeia might be placed among the stars after her death. It is to this myth the poet Milton alludes in "Il Penseroso":—

> "Hail, divinest Melancholy,
> Whose saintly visage is too bright
> To hit the sense of human sight,
> And therefore to our weaker view
> O'erlaid with black, staid Wisdom's hue;
> Black, but such as in esteem
> Prince Memnon's sister might beseem,
> Or that starred Ethiop queen that strove
> To set her beauty's praise above
> The sea nymphs, and their powers offended:
> Yet thou art higher far descended."

The same divine honour was awarded her daughter Andromeda, together with Perseus, her deliverer; and, strange to say, the great sea monster finds a place among the constellations. But of these we will have more to say in the following chapter.

According to science-history—which is much more reliable—in the year 1512 there appeared a new star in this constellation—namely, *Cassiopeia*, occupying a place which had previously been blank, It was first perceived by Schuler, of Wittemburg, on the 6th August, and by Tycho Brahe, the Danish astronomer, on the 11th of the following November. He did not see it at half-past five when returning from his laboratory, but returning about ten he came to a crowd of country people who were staring at something behind him. Looking round, he saw this wonderful object. It was so bright that his staff had a distinct shadow; it was of a dazzling white, with a bluish tinge. It had no tail or hair around it to indicate its being a comet, but shone with the same kind of lustre as the other fixed stars. Its brilliancy was so great as to surpass that of *Vega* or *Sirius*, by some it was thought to surpass in size and splendour the planet Venus in its greatest lustre. It was even seen by those who had good eyes at noon-day, a circumstance that never happens with the other stars except during an eclipse. It continued to shine with undiminished splendour during November, after which it gradually declined in size and brightness till, in the month of June, it was about equal in magnitude with the other stars in *Cassiopeia*, which are mostly of the third magnitude. Thus it continued to grow less, till in March of the following year it finally disappeared, and has never been seen since. It was remarked that, as it decreased in brightness, it also changed colour. When at its largest it was white and brilliant, then of a yellowish tinge passing into red, like that of Mars, or *Aldebaran.* Latterly it became of a livid white, and so continued till it vanished.

It has been computed that this wonderful sun, or star, was sufficiently large to have filled the space included in the earth's orbit, which is nearly 190 millions of miles in diameter, and perhaps not less than a hundred times the size of our sun. In brightness it must have been equal to that of the sun, while its motion was computed to be at the rate of four hundred and sixty-two millions of miles a minute—a velocity of which we can have no conception. The philosophers of that age, who were more theological than scientific, differed in their opinions of the cause of the phenomenon. Some were of the opinion that in it they beheld the conflagration of some distant world, on account of the wickedness of its inhabitants; others, that it foretold some great event, such as the second coming of the Lord. The modern explanation is that it was a star or sun of immense magnitude, whose orbit forms an elipse, the longer side of which is in the direction of our eye; consequently we are in a position to see it as it approaches and leaves the point nearest to us. It is said to have appeared in the same constellation in the year 945, as also in 1264—thus giving it a revolution of about 319 years. So that we may expect to see it reappear in the year 1891 or 1892.

The constellation *Lyra* or the Harp, as we have already shown lies about midway betwixt *Cassiopeia* and the Great Bear, and is distinguished by its chief luminary, the bright and beautiful star *Vega.* According to Sir William Herschell, the diameter of this star amounts to about 38 times that of our sun. Now, when we take into consideration the fact that our sun is equal to 1,300,000 globes as large as the earth, and that it has a surface in amplitude fifty-three millions seven hundred and seventy-thousand times larger than the view from Mount Etna —comprising an extent of forty-five thousand miles—what shall we say to an orb 38 times larger? "The magnitude of such a globe," says Dr. Dick, "is altogether overpowering to the human imagination, and completely baffles every effort to approximate to a distinct conception of an object of such amazing amplitude and splendour."* How great, how inconceivable then must be its distance from us, to whom it appears but a mere brilliant point of light!

In connection with this constellation are some remarkable phenomena, as for example the curious phenomenon of four stars revolving round each other. These are arranged in pairs of two, and one revolves round the other in one thousand years, while the second requires about double that period. Then, strange to say, the one pair revolves round the other in a period, which, determined from their distances, cannot fall much below a million years. This constellation also contains a nebula, which, like our own Milky Way, is in the form of a ring, and which is considered to be one of the most curious and interesting objects in the heavens. It can only be seen with the aid of the telescope, through which it appears as a ring of misty light hung in the heavens, with an apparent diameter about equal to that of the moon. It is supposed to be a vast congeries of stars, or matter in the process of becoming such, united into one grand system similar to that which forms the Milky Way of our own system, but so remote, that its light, travelling at the rate of 185,000 miles every moment of time, cannot reach us in less than twenty to thirty thousand years. So that, were that remote stellar universe blotted from the fields of space now, we would still continue to behold it for twenty thousand years after its annihilation. "Such distances," one writer has well said, "are amazing, and almost terrifying to human imagination." Our own nebulous zone, the Milky Way, may be seen any clear night from the autumnal till the vernal equinox. It appears to the naked eye a broad, irregular stream of misty light, stretching across the sky—with a few breaks or interruptions—from one side to the other; and when traced throughout its whole extent it is found to encircle the whole sphere of the heavens. It may be traced from *Auriga*, passing through *Cassiopeia*, and on in the direction of—but not touching—*Lyra*. It then reaches *Cygnus*, or the Swan, where it separates into two branches. The Swan is located just in the fork of the dividing streams, and is easily recognised by its three principal stars forming the top of a cross, thus— ⁎*⁎ Farther on, on the southern branch of the Milky Way lies *Aquila*, or the Eagle, with its bright star *Altair;* it may be known by its three principal stars forming a line, the middle one, *Altair*, being the brightest.

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* *Sidereal Heavens*, p. 65.

The ancients seem to have conjectured that the whiteness of this zone was due to a confluence of stars, as appears from the following lines from Ovid:—

> "A way there is in heaven's extended plain,
> Which when the skies are clear is seen below;
> And mortals by the name of Milky know;
> The ground-work is of stars, thro' which the road
> Lies open to the Thunderer's abode."

Milton, in his "Paradise Lost," alludes to it in these lines:—

> "A broad and ample road, whose dust is gold,
> And pavement stars, as stars to us appear;
> Seen in the galaxy, that Milky Way,
> Like to a circling zone powdered with stars."

This, in more recent times, has been amply confirmed by the telescope, particularly that constructed by Lord Rosse; while so numerous are the stars composing it, that in a space not much more than twice the breadth of the moon we can trace more of those sparkling luminaries than all the stars visible to the naked eye throughout the whole canopy of the heavens. And to think that each of these twinkling points may be equal to, if not larger, than our own sun, which occupies a place in the thinner portion of that immense zone! "There is not," says Dr. Dick, "another scene in creation open to the view of mortals calculated to fill the soul with more august conceptions, or to inspire it with more profound admiration and awe. You seem to penetrate, as it were, to the remotest boundaries of creation, and feel bewildered and lost amidst the immensity of the universe." And how much is this feeling enhanced when we remember that each of those resplendent suns may be—as is supposed—furnished like our own with a retinue of planets, with their attendant satellites!

The constellation *Lyra* received its name from the Greeks, in order to do honour to the lyre of Orpheus. Now, if—as was urged by more than one eminent divine of other days—the stars were the blissful habitations of the great and good who have passed the term of their probation here, we might be pardoned for supposing that the souls of the poets would be relegated to the regions of *Lyra*, and that the nebulous zone referred to was the halo arising from such a confluence of poetic genius as must have accumulated there from age to age. Alas, that such men as Lockyer and Huygens should intrude amongst us, with their telescopes and spectroscopes, to dissipate our dreams by telling us that even *Vega* itself, grand and glorious as it appears to be, is but a mass of incandescent vapour, or at best a storm of meteoric stones and gravel heated to a white heat preparatory to being welded into a planetary system thirty-eight times larger than our own, and which for millions of ages may not be in a condition to support even a blade of grass.

The bright star *Capella*, which occupies a position on the other side of the Pole-star from *Vega*, is, as we have said, in the constellation *Auriga*, or the Waggoner. It is so called from its relation by position with Charles's Wain, the old English name of the *Great Bear*. On charts of the heavens he is represented as carrying two young goats on his left arm, and bearing a whip in his right hand, with which he is supposed to be urging on the waggon. So that, looking on *Ursa Major* in the light of such a vehicle, it will appear as moving away from *Auriga*, and directly towards *Lyra*. But looking upon it as a bear, or even a plough, the movement will be in the opposite direction.

In connection with these four prominent constellations there is another, which, being also distinguished by having a bright

star of the first magnitude, some might be apt to mistake for *Vega.* It is the star *Arcturus*, in the constellation *Boötes*, or the Bear-driver. And this latter name will serve to indicate its position. It may easily be found by continuing the curve formed by the Bear's tail. Along with two other stars it forms a magnificent triangle, with one star near the centre. Of these three stars the brightest is *Arcturus*, the lowest on the right of the diagram. This, with the upper, and the other small stars, forms the constellation *Boötes.* The lower star, to the left, belongs to the constellation called the Northern Crown *(Corona Borealis).* The name *Arcturus*, is formed from two Greek words, the one signifying *bear*, and the other, *tail.* Being a star of the first magnitude, it was well known to the ancients. It is mentioned in Job, as also by Virgil. But the Greeks also gave the name *Arctus* to the Greater and Lesser Bear. In mythology, *Boötes* is said to have been condemned to hunt the two Bears round the Pole-star forever. The star *Epsilon*, in the same constellation, when subjected to a highly magnifying instrument, is found to be a double star. It is reckoned very beautiful, on account of the different colours of the stars of which it is composed, and has the appearance somewhat similar to a planet and his satellite. The small star is of a bluish colour, and is separated from the other only by the space represented by the breadth of the larger star. It is called *Mirac*, and is situated about ten degrees north-east of *Arcturus.* The largest star in the constellation, *Corona*, is one of the second magnitude. It is sometimes called the Pearl of the Crown, but its proper name is *Alpheca. (Dia. V.)* The stars of this constellation are arranged in semi-circular form, and in their present position resemble a bowl or basin, but in its inverted position, the constellation is said to resemble a crown, hence its name of *Corona* or the Crown. Its position is to the left of the bright star *Arcturus*, and only some two or three degrees distant from it. In May, 1866, a star of the tenth magnitude in this constellation, suddenly increased in size and brightness to one of the second magnitude. The phenomenon was well examined by spectroscopists, and declared to be caused by the hydrogen surrounding the star being raised to an intense degree of heat. A change in our own sun's lustre equal to that which occurred in the star in *Corona*, would (says R. A. Proctor) "unquestionably destroy every living creature on the face of the earth; nor could any even escape of those which may exist on the other planets of the solar system." From the same eminent astronomer we learn—that an increase in our own sun to tenfold its present brightness, would prove the destruction of all forms of vegetable and animal life; and yet that of the star in *Corona* was 800 times greater.

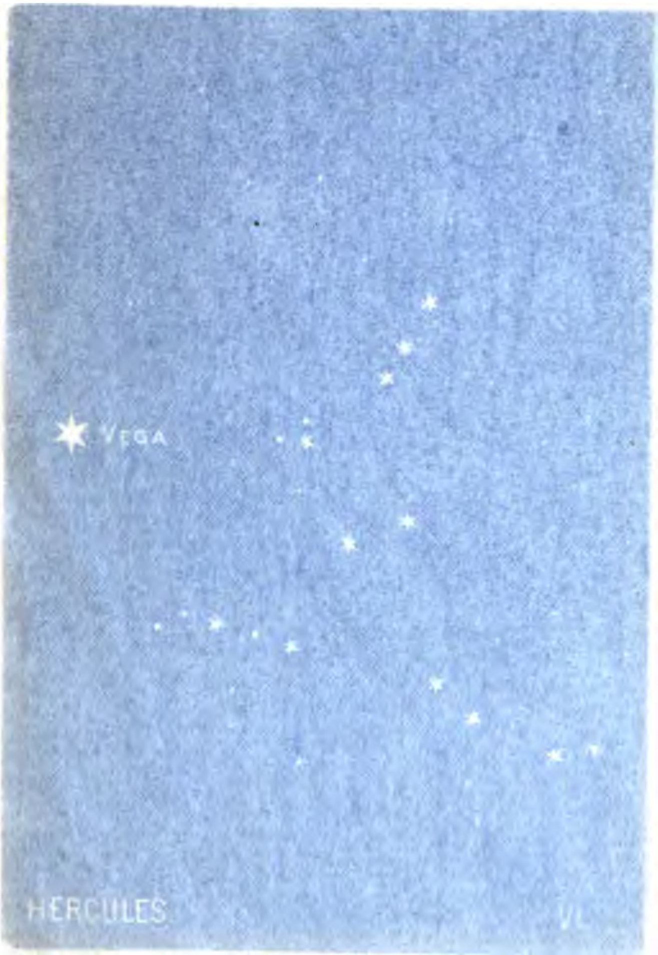
The general opinion of astronomers now is, that these sudden accessions of splendour in known stars, is caused by the heavy downfall of meteoric showers upon their surface, according to the well known law of transmutation of force, by which motion is changed into light and heat, or *vice versa*. But in the case of our own sun this theory of accounting for his unfailing power, has been abandoned, and that simply from the fact that no such continuous down-pour of meteors on his surface is known to exist. It is thought that such showers do occasionally fall upon the surface of the sun, and sufficient to cause slight disturbance in the supply of light and heat. It is also believed that the occurrence of solar spots are in some way connected with the fall of meteors.

There is one constellation betwixt the last named and *Lyra*, which we must not omit—namely, *Hercules*, so named after the great mythological hero of that name. In figured charts of the heavens he is represented as a gigantic warrior with an immense club in his right hand, and kneeling on his right knee. The constellation, as seen in the sky, bears no such resemblance, but is thought to be somewhat in the form of a great lily, opening towards *Vega*, and with its stalk bending under the crown; but to our thinking it is more like a colossal pitchfork or trident, with its three prongs opening towards *Vega*. It is towards one of the stars in *Hercules* that our sun and his system of planets is said to be travelling. *(Dia. VI.)*

CHAPTER III.

November—Altered Position of the Constellations—What may be seen from an attic window—The Cassiopeian Family; *Cepheus*, *Perseus*, *Andromeda* and *Pegasus*—*Algol*, or the Demon-star—The Double Star *Almach*—Greek names and mythology of the Stars borrowed from India—The Great Square of *Pegasus*—*Cetus*, the Whale—*Cygnus* the Swan—Distance of nearest Star—How measured—61 Cygni—New Stars and their significance.

By this time (November) the various star-groups of which we have been treating will, to a considerable degree, have altered


VEGA
HERCULES
VI.

[illegible] other planets of the solar system." From the [illegible] we learn—that an increase in our own [illegible] present brightness, would prove the destruction [illegible] and animal life; and yet that of the [illegible] times greater.

[illegible] of astronomers now is, that these sudden [illegible] known stars, is caused by the heavy [illegible] upon their surface, according to the [illegible] of transmutation of force, by which motion is [illegible] heat, or vice versa. But in the case of [illegible] of accounting for his unfailing power. [illegible] that simply from the fact that no [illegible] meteors on his surface is known [illegible] thought that such showers do occasionally fall [illegible] of the sun, and sufficient to cause slight dis[illegible] the supply of light and heat. It is also believed [illegible] of solar spots are in some way connected [illegible] of meteors.

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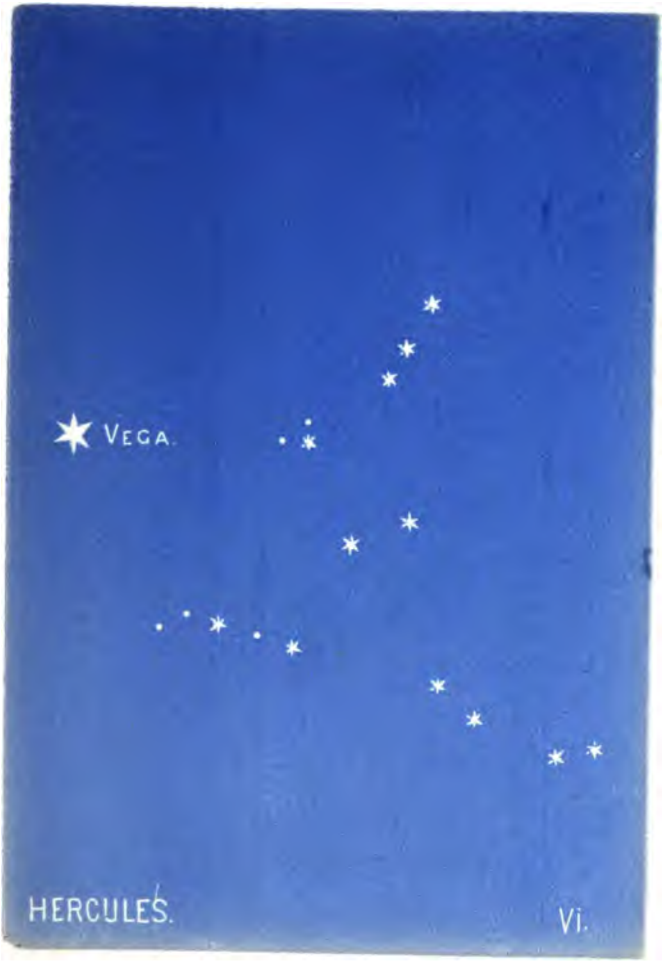
CHAPTER III.

[illegible] the Constellations—What may be seen [illegible] The Cassiopeian Family; *Cepheus*, *Perseus*. [illegible]—*Algol*, or the Demon-star. The Double [illegible] and mythology of the Stars borrowed [illegible] of *Pegasus*—*Cetus*, the Whale—*Cyg*[illegible] nearest Star—How measured—61 Cygni—New [illegible].

By this t[illegible] various star-groups of which we have been tr[illegible] considerable degree, have altered



HERCULES.

VI.

their positions. The Great Bear, which at the opening of our first chapter occupied a position to the north-west, with his tail slanting southwards, will now be climbing the northern sky in the direction of *Auriga*, his caudal appendage directed towards the western horizon. *Cassiopeia*, on the other hand, will be enthroned to the south of the Pole-star high up in, or near to, the zenith. *Vega* will be shining brightly in the west; and, following suit, *Capella* will be smiling a benignant response from the east. Very fortunately for us the bow-window of the little attic room in which we write, commands a pretty extensive view of the eastern portion of the celestial dome. We say fortunately, for it is a rare thing for us town-dwellers to be so situated. With those who have the good fortune to reside in the country it is far otherwise; those especially who live on, or near to, the sea coast, what splendid opportunities they have of studying the stars! Having thus a field of view extending from the north-east to the south-west, we have within our ken a magnificent arc of the circle known as the Ecliptic, or "Yoke of the Sky." This may be said to be the great highway along which the Sun, Moon, and Planets, perform their respective journeys. Nor is this merely an imaginary line invented for the convenience of astronomers, but a veritable pathway paved all round its course with splendid astral groups and constellations, so placed in relation to each other, as to form a complete zone or belt round the heavens, and known as the Twelve Signs of the Zodiac. Thus, without moving our seat, we are able to watch, night after night, and month after month, this magnificent panorama, while Mother Earth is swiftly bowling round the starry circle, and thus affording us the opportunity of witnessing the grand procession.

Strange, we sometimes think, that of the intelligent millions struggling for existence in the mighty hive of humanity beneath, so few seem to be possessed of the instinct—not to say the desire—to look up into those serene depths in order to drink in the placid beauty of those glorious orbs, night after night looking down upon us with their bright eyes beaming as with love and kindly sympathy, and no doubt intended to lift our thoughts to that Being who is the source and centre of all life and motion, as well as the infinite fountain of light, and love, and wisdom, and goodness, and in whom—as the Good Book tells us—"*there is no darkness at all.*"

Stretching round from *Capella*, in the direction of *Vega*, there is a magnificent chain of stars forming an extended and somewhat irregular line; and being mostly of the second magnitude, they are not difficult to trace. They are the leading stars in three distinct constellations, namely, *Perseus*, *Andromeda* and *Pegasus*, or the winged horse *(Dia. VII).* The first in the chain, and that nearest to *Capella,* is on the breast of the warrior *Perseus*; the second, third, and fourth outline the recumbent figure of the lady *Andromeda,* that nearest to *Perseus* representing her feet, and named *Almach.* The star representing her head is separated from that forming her loins by three stars of lesser magnitude which run crosswise and represent her breast and shoulders. To the right of *Andromeda* lies what is called the "Great Square of *Pegasus*," one of the four stars of which it is formed being that which does duty for the head of *Andromeda.* The two forming the right hand side of the Great Square are named *Markab* and *Sheat*, *Sheat* being the *upper* and *Markab* the *lower;* while the two forming the left side are *Alpheratz* (upper) and *Algenib* (lower). From *Sheat* a row of small stars run slanting upwards to form the fore-feet of the winged steed, while from *Markab* a similar row slant downwards and form the neck and head, consequently he is flying head downwards and feet upwards.

The lower of the two stars in *Perseus* is *Algol*, in the head of *Medusa*, which the warlike figure holds in his left hand by the long serpentine locks, while in his right he holds a sword. This Perseus—favourite of the gods—was the son of Jupiter by Danæ. Among other great feats he killed the Medusa, a monster that had the power of turning every living thing she looked upon into stone. Having killed her he brought away her head, from the blood of which sprung Pegasus, the winged steed, mounting which he went in pursuit of the great sea monster to which the beautiful Andromeda was exposed.

One of the most remarkable of what are known as *variable* stars is this same star *Algol*, in the head of the *Medusa.* It had long been known to present different magnitudes at different times, but its period of change was not ascertained till the year 1783. It changes continually from a star of the second to that of the fourth magnitude. While watching it, it is seen to diminish in splendour, and to decline in brightness, until scarcely visible to the naked eye. Having reached a certain limit it begins to increase, and by slow degrees

[illegible] stars forming an extended [illegible] are [illegible] of the second magni- [illegible] They are the leading stars [illegible] and [illegible] The first in the chain, [illegible] is on the breast of the warrior [illegible] and fourth outline the recumbent [illegible] that nearest to [illegible] represent [illegible] The star representing her [illegible] by these stars [illegible] and represent her [illegible] of *Andromeda* lies what is called [illegible] one of the four stars of which [illegible] which [illegible] duty for the head of [illegible] the right hand side of the Great [illegible] *Markab* and *Scheat*, *Scheat* being the *upper* [illegible] while the two forming the left side are [illegible] (lower). From *Scheat* a [illegible] upwards to form the [illegible] of the [illegible] *Markab* a similar row slants downwards [illegible] he is flying [illegible] upwards.

[illegible] in the head of [illegible] holds in his left hand by the [illegible] in his right he holds a sword. This [illegible] was the son of Jupiter by [illegible] he killed the Medusa, a [illegible] power of turning every living thing [illegible] stone. Having killed her he [illegible] the blood of which sprang Pegasus, [illegible] he went in pursuit of the [illegible] the beautiful Andromeda was

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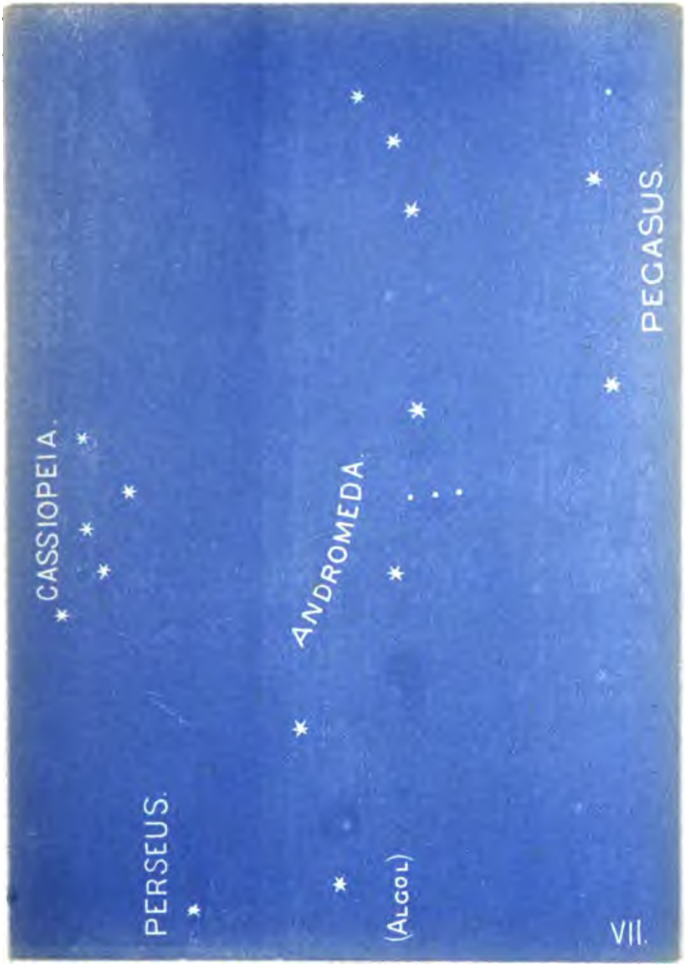
CASSIOPEIA.
PERSEUS.
(ALGOL)
ANDROMEDA.
PEGASUS.
VII.

to assume its original splendour, this decrease and increase being accomplished in about eight hours. Having regained its original light, it remains stationary for about two days and a half, and then repeats the changes already described. Another star of this description is the bright star *Beta*, in *Lyra*, which passes from the third to the fifth magnitude, and regains its light in a period of six days nine hours. As to the cause of these phenomena the opinions of astronomers are exceedingly conflicting and unsatisfactory. Some have attributed them to dark spots on the surface of the stars, which by rotating on an axis, periodically present themselves, and thus dims their lustre. Others think such changes due to the revolutions of large planets about the stars, which by coming between the eye and the star eclipse a portion of its light. While a third class attribute the phenomena to the excessive elongation of their orbits being so located as to have their greater axis towards our system. This star reaches the meridian on the 21st December.

Here, for the sake of our younger readers, it may be as well to explain that by the meridian is meant that point in the heavens which the sun occupies at twelve o'clock noon, which is due south, so that from this point to that representing due north is the line of the meridian. Crossing this line at right angles is that of the equinox, connecting the east and the west; the sun crosses it twice in the year—namely, on the 21st March, and on the 21st September; the former he crosses twice in the twenty-four hours—namely, at twelve o'clock noon, and at midnight.

Almach, in the left foot of *Andromeda*, is a fine example of what are called double stars; it is accompanied by one of smaller magnitude, at a distance of about four times its own diameter, and is of a greenish blue colour, while that of the larger star is red. The stars of the southern heavens are said to present a greater variety of vivid colours than those of the north. Yet in the north there are some beautiful specimens of double stars, in which vivid colours are beautifully contrasted. Orange and blue are of frequent occurrence, while red and green are less common. The condition of planets revolving round a sun whose light is orange or red associated with another sun whose light is blue or green, may be more easily conceived than described. The exquisite mingling of hues, produced by this double illumination, must exceed anything within the limits of the changes due to our own planet. "One hemisphere of such a planet," says Dr. Dick, "may be illuminated with a yellow sun, while the other is at the same time enlightened by a green, and both suns may occasionally shine in the same hemisphere, producing such a blending of hues and a contrast of colouring over the whole landscape as to render the aspect of the scene completely different at one time from what it is at another. In different parts of the planets' courses around their primary suns these effects will be variously modified, so as to produce an almost perpetual variety in the scenery of such worlds." Isolated stars of a red colour, almost as deep as that of blood, occur in many parts of the heavens; the star *Eta* in *Cassiopeia*, for example, exhibits the beautiful combination of a large white star and a small one of ruddy purple.

Had the beautiful phenomenon of double stars been familiar to the ancients, we are persuaded that *Venus*, beautiful as she is, would not have occupied unchallenged the position of being the tutelary divinity of love, or

> "That star to all true lovers dear."

Might we, therefore, suggest that for the future *Almach* and her faithful campanion, rather than *Venus*—which is only a paltry planet—be looked up to as the patrons of those who are the subjects of the tender passion, and that henceforth all sweethearting be done under their benign auspices?

To some minds it may seem a trivial matter that certain stars which, viewed with the naked eye, appear as one, are, by the magnifying power of the telescope, found to be pairs revolving round each other periodically. Yet, to the deeply reflecting mind, such phenomena are of the highest importance, for they reveal facts upon which is based perhaps the grandest discovery of modern astronomical science, namely, the universal prevalence of the law of gravitation, by which planet is linked to sun, and moon to planet; and not only this, but sun to sun and system to system throughout the boundless universe. How this great discovery came to be made, we shall see presently. Meanwhile it will thus be seen that the constellations we have just been considering, are quite a family group, and also that they are peculiarly Grecian. First we have *Cepheus*, King of Ethiopia, while not far from him sits his queen *Cassiopeia*; then we have, a little farther out, their daughter, the fair

Andromeda, with *Perseus*, her heroic deliverer. Next we have *Pegasus*, the winged steed, which bore him in pursuit of the great sea monster. He is also fabled to have opened the fountain of Hypocrene with a blow from his hoof. At last he flew away up to heaven, where he was changed into the constellation which bears his name. Then, to complete the group, we have the great sea monster itself in the adjacent constellation of *Cetus*, or the Whale. Yet it does not seem clear that the Greeks were the originators of the names borne by these constellations. On the contrary, there is evidence which leads us to think that the Greeks only copied them from some more ancient tribe or nation, and altered them to suit their own particular myths. It would appear that similar names were used for the same constellations by the Hindoos. This is inevitably proved by what is related by Wilford ("Asiatic Researches") of his pundit, an astronomer, on the names of the constellations. "Asking him," he says, "to show me in the heavens the constellations of *Antarmada*, he immediately pointed to *Andromeda*, though I had not given him any information about it beforehand. He also brought me a very rare and curious work in Sanscrit, which contained a chapter devoted to *Upanacchatras*, or extra-zodiacal constellations, with drawings of *Capuga* (Cepheus) and of *Cassapi* (Cassiopeia), seated and holding a lotus-flower in her hand; of *Antarmada* charmed with the fish beside her; and last, of *Parasiea* (Perseus), who, according to the explanation of the book, held the head of a monster which he had slain in combat; blood was dropping from it, and for hair it had snakes." Besides this, it will be observed that the names of the individual stars have more of an oriental ring about them, as *Algol*, *Algenib*, *Phad*, *Alioth*, *Almach*, *Sheat*, *Alpheratz*, etc., than is characteristic of the Greek.

The Great Square of *Pegasus* now occupies the line of the the meridian, the two stars *Sheat* and *Markab* being to the right; the other two, *Alpheratz* and *Algenib*, being to the left of it. A line drawn through these two last will also pass through *Caph*, the right-hand star in *Cassiopeia*, and also touch the Pole-star. Or reverse the process, and draw the line from the Pole-star through *Caph*, and we come to find the left side of the Great Square in *Pegasus*. Then, if we wish to include the Whale in this family group of planets, we have only to continue the line a considerable distance farther to the south, and we will come upon the bright star *Mira*, which is the principal star in *Cetus* or the Whale.

Passing round in the direction of *Vega* there is yet another constellation which we must not overlook—viz., *Cygnus*, or the Swan: and the more so that one of its stars possesses a historical importance that gives it more than a passing interest. This is due to the fact that it was the first star which revealed its distance by parallax. The principle of this mode of measurement will be roughly understood by the following familiar illustration:—Supposing that, in travelling along a line of railway, we observe a distant object, say a church-spire, and say that there is beyond it some other well-defined object, as a tower or a tree, it will be found that the distance betwixt the two objects increases as we move along, so that they seem as if moving away from each other; this divergence is not due to any alteration in the relative positions of the objects to each other, but to the altered position of the observer; the which divergency in the object so viewed is termed its parallax. And to ascertain the distance of any such object it is necessary that it be viewed from each of the ends of the base line along which we are travelling, when the amount of divergency of the object, taken in connection with the length of the base line, will give the distance of the object. By this method astronomers had already ascertained the distance of the moon and planets, and even of the sun himself; but to accomplish this it was found that the diameter of the earth, amounting to eight thousand miles, did not afford sufficient space for a base line. In these circumstances there remained but one alternative, and that was to take the diameter of the earth's orbit—amounting to one hundred and ninety million miles—for a base line. As a matter of course this could only be accomplished in the space of six months, so as to give the earth time to pass from the one side of her orbit to the other. But even with this enormously extended base line, one astronomer after another failed to obtain the parallax of any one of the fixed stars. Among others, Sir William Herschel entered the field confident of success, and well he might, armed as he was with his great forty-feet telescope. To his great joy he detected movements and divergences in some of the double stars, but he soon found that such movements were not due to parallax; in short, he made the grand discovery already referred to of *revolving* stars. These unlooked for phenomena so entirely occupied his attention that he proceeded no farther in the attempt to solve the problem of parallax. Dr. Bradley was the next to make the attempt, and though he did not succeed in finding divergence in any of the stars due to parallax, he made other important discoveries which cleared the way for those who followed him in the same track. Professor Bessel, of Konigsberg, next undertook the solution of the problem, and in doing so directed his attention to a double star in the Swan known as 61 *Cygni,* in other words, No. 61 of that constellation. This star, for various reasons, seemed to him to afford him the best chance of success. He continued his experiments every night on which the star was visible for more than a year, and found as the result that a small amount of divergence had taken place—an amount sufficient to enable him to determine the distance of the star, which is equal to sixty-two billions four hundred and eighty-one thousand five hundred millions of miles. To satisfy himself that there was no mistake he repeated his experiments and calculations again and again during the space of four years before he ventured to give his discovery to the world. By this discovery it was found that the nearest stars are at least three times farther distant than they were supposed to be.

The nearest approximation we can have to a conception of such enormous distances, is by calculating the time it would take for light to reach us from such a body. Light, as we have elsewhere said, travels at the rate of about 92 millions of miles in eight minutes, or at the rate of 185,000 miles every second of time; yet light, inconceivably swift as its motion is, would require 10 years and 114 days to fly across this mighty interval separating us from the star 61 *Cygni.* Be it remembered, however, that at one point of the earth's course, we are ninety-two millions of miles nearer to it than when we are at the opposite or farthest away side. A cannon ball moving at the rate of five hundred miles an hour, would require fourteen million two hundred and fifty thousand four hundred and eighteen years to move across such an immense interval. And when we reflect that were it even possible to pass such a distance, even then we would find ourselves but on the extreme verge of the starry firmament, where ten thousand other orbs, a thousand times more distant, would still invite us on, we are fain to recall our baffled thoughts, and to declare that the wondrous works of God are truly past finding out.

Diagram VIII. will give the reader an idea of the form of the constellation *Cygnus* or the Swan. It is shaped like the half of a wheel, and, in its present position in the heavens, not unlike the upper part of an arched window, while the four larger stars present the figure of a cross. Besides those we have given it contains a number of stars of lesser magnitude, including the star 61 *Cygni*, which is of the fifth, and just visible to the unaided eye. A line drawn from *Algenib*—the star which forms the lower left-hand corner of the Square of *Pegasus*—to *Vega*, will pass through *Deneb*, the principal star in the constellation.

The constellation is no less marked for the production or exhibition of new stars. Not less recently than 1876, one of these made its appearance. Occupying a hitherto empty space in the field of the constellation—a spot whereon no star was visible the night previous—shone what appeared to be a star of the third magnitude, and presenting a strong yellow colour. When the light was tested by spectroscopic analysis, it was found that its rays showed their lines in the instrument similar to those of our own sun, thereby indicating that the star in question contained in its luminous envelope certain chemical elements which are also present in the gaseous envelope of our own luminary. The brilliancy of the star rapidly diminished after its first appearance, so that on the 6th of December it was reduced to the sixth magnitude, and on the 15th to the seventh; and after this date it ceased to be visible to the naked eye, and continued slowly to disappear.

One significant fact in connection with this phenomenon is the identity of the lines produced by its rays in the spectroscope with those produced by the light from our own sun, thus leading us to the conclusion that the elements of which not only they, but all the other orbs in infinite space, are composed, are identical in their character. From spectral analysis we learn that the luminous envelope of our sun contains most, if not all, of the elements of which our earth is composed, earth and the other planets in our system being only detached and condensed portions of the great incandescent mass of the sun's orb, sufficiently cooled to afford the conditions necessary to the existence of their myriad inhabitants. And as the elements of all that we see around us have been derived from the sun, it is but reasonable to infer that the magnificent orbs with which infinite space is filled are also the parent suns of countless

[illegible] idea of the form [illegible] is shaped like the [illegible] present position in the heavens [illegible] while the four [illegible] Besides those we [illegible] stars of lesser magnitude [illegible] which is of the fifth, and [illegible] A line drawn from [illegible] the Swan [illegible] through [illegible], the principal star [illegible]

[illegible] marked for the production [illegible] than 1876, or [illegible] a hitherto empty spa[illegible] spot whereon no star was [illegible] what appeared to be a [illegible] presenting a strong yellow colour [illegible] spectroscopic analysis it [illegible] lines in the instrument simil[illegible] indicating that the star [illegible] in its envelope certain chemi[illegible] present in the gaseous envelope of [illegible]ary. [illegible] of the star rapidly diminish[illegible] so that on the 9th of December [illegible] sixth magnitude, and on the 15th to the [illegible] it ceased to be visible to the [illegible] to disappear.

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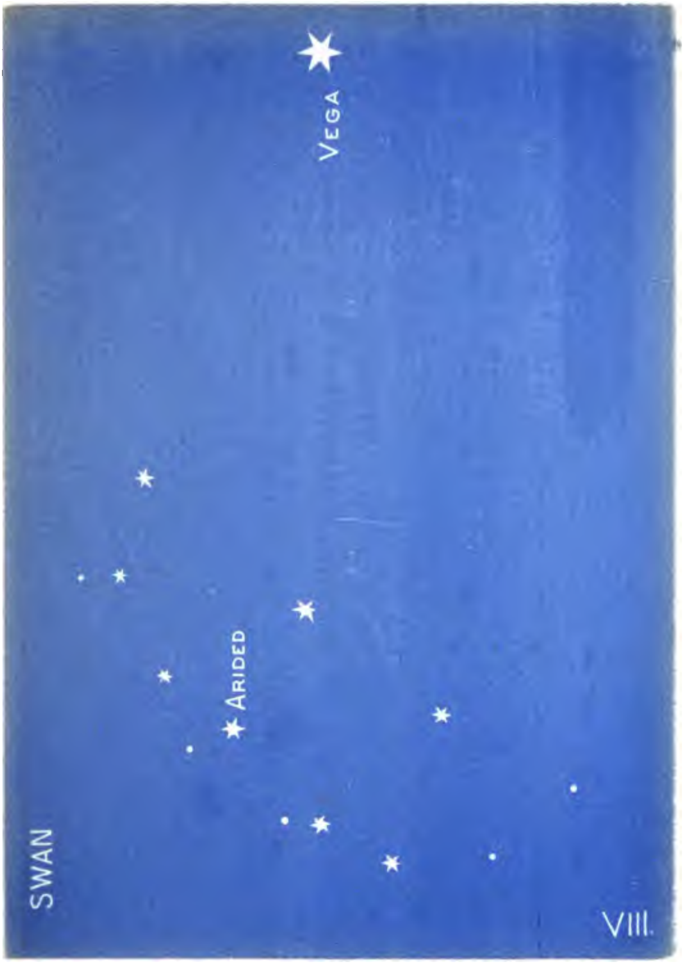

SWAN
VEGA
ARIDED
VIII.

planetary worlds, which are either inhabited or in various degrees of preparation for being so; and though such worlds may be—and must necessarily be—invisible to us, we have no reason to doubt their existence. Judging from the present condition of our own sun, which is that of tempestuous and tremendous activity arising from its incandescence, those far distant and superior orbs must also be centres of tremendous force and energy, radiating forth light and heat—the essentials of life—not to desert wastes of empty space, but to countless worlds rejoicing as they revolve around their grand and glorious primaries.

CHAPTER IV.

The Heavens in December—Constellations seen in the morning—Equatorial Stars and Constellations—The Signs of the Zodiac, their origin, division, and signification—Chinese names for Zodiacal Constellations—The Shepherds of Chaldea the First Astronomers—Scriptural allusions to the Constellations—Star-worship of the Ancients.

Now that we have reached the "dark howe o' the year," December may be said to be the very best season for viewing the celestial scenery, seeing that the stars make their appearance as early as five P.M., and continue till at least eight o'clock in the morning. Looking towards the north at from eight to ten P.M., the Great Bear will be seen with his tail hanging vertical to the horizon, *Benetnach*, the star forming its tip, being very near to it. Following with our eye the line of the pointers through the Pole-star, we find *Cassiopeia* very near to the zenith, or highest point overhead, with the Double-u lying right along the Milky Way. This mighty river of stars now forms one vast arch stretching from horizon to horizon, from *Aquila* in the north-west to *Canis Major* in the south-east. About midway betwixt *Cassiopeia* and the western horizon will be found the Swan, just where the Milky-Way begins to divide into two separate branches, one of its principal stars, *Arided*, lying in the fork, and forming, along with the four next in magnitude, the figure of the cross, of which *Arided* is the top. Our old friend *Boötes*, the Bear-driver, is now, with the exception of two of his smaller stars, beneath the horizon, but sure to make his appearance about five or six in the morning, while in order to see him again in the evening we will have to wait till February.

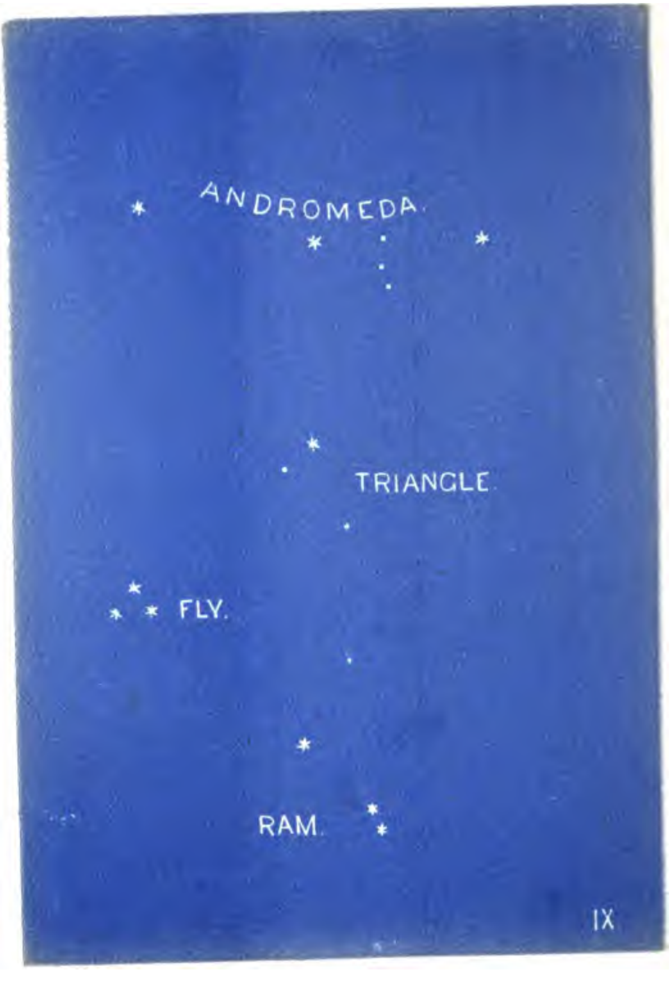
We remember when first we began to take note of the constellations, when repairing to our work in the mornings, how bewildering it was to find the Plough, which on the preceding evening was low down in the northern horizon, now high up in the zenith, and to the south of the Pole-star; while *Cassiopeia*, which had been in the zenith the night before, was now low down in the north. But of course, it was the earth that had gone round, and not the constellations. In consequence of this, we get quite a different view of the starry heavens in the morning; for then many constellations are brought into view that are invisible at night, they being beneath the northern horizon. In this way we are privileged with the view of constellations that will not be seen in the evening till the spring months, March and April. *Andromeda* is now high up, her feet near the zenith, and nearly touching the Milky Way, in the direction of *Cassiopeia*, her mother. Meanwhile *Pegasus* is marching steadily in the direction of the western horizon.

Having in our celestial survey now gone the round of the principal circumpolar constellations, we are in a position to extend it to what is known as the equatorial regions of the celestial sphere, and which is traversed by that broad highway of constellations which bears the name of the Zodiac, so called from the fact that the majority of the constellations composing it take their names from animals. The constellations are twelve in number, being named and arranged as follows:—*Aries*, the Ram; *Taurus*, the Bull; *Gemini*, the Twins; *Cancer*, the Crab; *Leo*, the Lion; *Virgo*, the Virgin; *Libra*, the Balance; *Scorpio*, the Scorpion; *Sagittarius*, the Archer; *Capricornus*, the Goat; *Aquarius*, the Water-bearer; and *Pisces*, the Fishes. They are more briefly embodied in the following well-known rhyme:—

"The Ram, the Bull, the heavenly Twins,
And next the Crab and Lion shines,
The Virgin and the Scales,
The Scorpion, Archer, and the Goat,
The Man that pours the water out,
And Fish with glittering tails."

Here is a translation of a much more ancient poetical description of the Zodiac, by Lucretius:—

"The leader Ram, all bright with golden wool,
Looks back, and wonders at the mighty Bull,


ANDROMEDA.
TRIANGLE.
FLY.
RAM.
IX

Whose [illegible] parts first appear [illegible]
[illegible]
Thus [illegible]
[illegible]
Next him the [illegible]
[illegible]
Then [illegible] and mighty [illegible]
[illegible] at length [illegible]
And [illegible]
And [illegible]
The Centaur [illegible]
His bow [illegible]
The twisted [illegible]
The W[illegible]
Next their [illegible]
Join with the Ram [illegible]

[illegible] fortunately [illegible] perhaps [illegible] study of the Z[illegible] directly under *An*[illegible] with *Almach*, in [illegible] ally from *Almach* to [illegible] will [illegible] pass through a small [illegible] from its three princip[illegible] be reached [illegible] the lower side of [illegible] *[illegible]es* will by this time [illegible] *[illegible]asu* will have pass[illegible] west of

The Ram is easily [illegible] stars taking the form of a crook [illegible]

The Zodiac appears to [illegible] ents in the very earliest times [illegible] suggestive signs is attributed to the [illegible] Probably the merit is due to [illegible] adopted by the latter, who in [illegible] Greeks and other nations. Now, to [illegible] little misunder-standing in our study [illegible] and [illegible] at the outset, that the [illegible] and the groups of stars which constitute its [illegible] are not identical [illegible] separate and distinct [illegible] at first divided the path of the sun into twelve [illegible] to which they gave names signifying the various seasons and natural events of the year [illegible] the space occupied by the sun in March they named *A*[illegible] or the Ram, because it was the season when flocks increase [illegible] while to the space representing April they gave the name of

> Whose back-parts first appear; he bending lies
> With threatening head, and calls the Twins to rise;
> They clasp for fear, and mutually embrace;
> Then comes the Crab with an unsteady pace;
> Next him the angry Lion shakes his mane,
> The following Maid abates his rage again;
> Then day and night are balanced in the Scales,
> Equal awhile, at length the night prevails;
> And longer grown, the heavier scale inclines
> And draws the Scorpion from the winter-signs;
> The Centaur follows with an aiming eye,
> His bow full drawn and ready to let fly;
> The twisted Goat his horns contracted shows;
> The Water-Bearer's urn a flood o'erflows;
> Next their loved wave the Fishes take their seat,
> Join with the Ram, and make the round complete."

Very fortunately our last survey of the heavens ended at a point, perhaps of all others, the most convenient for commencing the study of the Zodiac, seeing that *Aries* its first constellation lies directly under *Andromeda.* Its brightest star *Hamal* lies in a line with *Almach*, in the feet of *Andromeda.* A line drawn vertically from *Almach* to *Hamal* in the head of the Ram, will also pass through a small constellation, known as the Triangle, from its three principal stars taking that form. The star *Hamal* may also be reached by a line drawn through the two stars forming the lower side of the great square of *Pegasus* to the left. *Aries* will by this time be on the line of the meridian, while *Pegasus* will have passed a considerable distance to the west of it. The Ram is easily known by its three principal stars taking the form of a crooked stick, as may be seen in *Diagram IX.*

The Zodiac appears to have been known to the ancients from the very earliest times, while the invention of its figurative signs is attributed to the Chaldeans, or to the Egyptians. Probably the merit is due to the former, from whom it was adopted by the latter, who in their turn gave it to the Greeks and other nations. Now, to prevent confusion and no little misunderstanding in our study of the Zodiac, let it be distinctly understood at the outset, that the *signs* of the Zodiac, and the groups of stars which constitute its constellations, are not identical, but separate and distinct things. The ancients at first divided the path of the sun into twelve spaces, to which they gave names, signifying the various seasons and natural events of the year; the space occupied by the sun in March they named *Aries* or the Ram, because it was the season when flocks increase; while to the space representing April they gave the name of

Taurus or the Bull, because at that season such animals were then of great service in ploughing the land. *Gemini*, the Twins (originally two young goats), the space or sign into which the sun passed in May, was the season when goats brought forth their young. June was called *Cancer*, or the Crab, because the sun at the longest day having reached its utmost point at setting, begins to recede, and so resembles the crab in its backward motion. July they termed *Leo*, the Lion, because at this season the sun gives out his fiercest heat; or, as others suppose, because at this season the lions were driven by the heat from their forest haunts to the banks of the rivers for water. The space representing August they termed *Virgo*, the Virgin, because at that season young maidens went forth to glean after the reapers. In September, the day and night being of equal length, they named that division of the sun's path *Libra*, the Balance. In October the sun was thought to have reached a division or space noted for the prevalence of disease, hence the name *Scorpio*, or the Scorpion. November being the hunting season, was named *Sagittarius*, or the Archer. December, the season when the sun has reached its lowest altitude, and so resembles the goat, which at this season is driven by the cold from its feeding places among the mountains and forced to seek the shelter of the valleys; hence *Capricornus*, or the Goat. The division represented by January was supposed to be exceptionally rainy, and was called *Aquarius*, or the Water-bearer. February was the great season for fish, hence the sun was said to have entered the sign or the division of *Pisces*.

By and by, however, as people became more literal, they began to trace the forms which these names represent in the stars that pave the path of the sun, and which of necessity occupy these divisions—not that these star groups bear any resemblance to these forms, with the exception of one or two, and even then the resemblance is exceedingly remote. It appears, however, that some nations arranged these into twenty-eight groups, being one for each night of the moon's journey round the earth. It had been long noticed that the moon rises on each successive night a considerable distance to the east of the point at which she rose on the night previous. This is owing to the fact that the moon is dependent on the earth, being bound to it by the attraction of gravitation, and consequently is drawn after her in her path *eastwards* round the sun.

The Chinese divided the Zodiac into twenty-eight parts, called *Nakshatrus* (mansions or hotels), because the moon remains in each of them for a period of twenty-four hours. In the Coptic and Egyptian the word for constellation has the same meaning. In the Book of Job—supposed to be written long before the time of Moses—reference is made to this in the passage—"Which alone spreadeth out the heavens, and treadeth upon the waves of the sea; which maketh Arcturus and Orion, and Pleiades, and the *chambers* of the south." The term "Mazzaroth," in the same book, is also supposed to refer to the same thing.

Now let us consider for a moment by what conceivable means those ancient Chaldean shepherds came to trace the course of the sun through the constellations of the Zodiac. The first thing to arrest their attention would be the diurnal motion of the whole heavens from east to west. This they would ascertain while tending their flocks throughout the long and silent watches of the night, from the fact that certain stars never set, but turn in a circle round a fixed point. The next question would then be, what becomes of the stars that *do* set and descend below the horizon, seeing that they rise in the same relative positions as those in which they set? On this account they could not be thought to be destroyed; but, though out of sight, only completing that portion of the circle that is beneath the horizon. The fact of those setting stars finding a path beneath the earth would then lead to the conception of the earth as a body suspended in space, with nothing to support it. They would also notice that the sun set along with certain constellations, now with one and now with another, and also that certain constellations seen during the nights of winter were different from those seen during the nights of summer; moreover, that a group of stars that passed the meridian at a given time would at the end of six months be replaced by the group occupying a position exactly opposite. From this it would follow that the sun, being exactly opposite the meridian at midnight, would be in conjunction with the constellation opposite to the meridian at that hour; and in this way the constellation of the Zodiac occupied by the sun could be at any time determined. If, for example, in those early times, they found the constellation of the Balance occupying the meridian in the month of March, they could say with certainty that the sun was in *Aries*, that constellation being immediately opposite to the other, though beneath the horizon. Now, however, it is found that the signs and the constellations of the Zodiac do not coincide, for in the month of March the earth has only reached to *Pisces*, consequently she has, from the times of the ancients to the present, fallen behind in her course a complete sign or division of the Zodiac. This retardation of the earth on her annual course is said to be caused by the attraction of the sun and moon on her equator; the diameter of the earth being greater at the equator than at her poles, the consequence is that she is being drawn by a slow, reeling motion from east to west, causing the line of the ecliptic to cross that of the equator each year, about one minute of arc to the east of where it crossed the year previous, the which shifting of the equinoctial points is termed the precession of the equinoxes. In the space of two thousand years the sun in the month of March will be in *Aquarius*, and at this rate in the space of 25,000,870 years the earth will have fallen behind a whole cycle; by which time the sun will once more pass into *Aries* in March, and the signs and constellations coincide with each other.

In the Book of Kings reference is made to the constellations of the Zodiac in the fact that the idolatrous kings built altars to all the host of heaven. This worship they doubtless imbibed from the Egyptians during their long sojourn among them. That in earlier times the Hebrews had adopted the divisions of the Zodiac, we think is evident from the statement in Genesis, that they—the stars—were appointed for signs and for seasons, and for years. In Joseph's dream there seems to be another allusion to the Zodiac, when the sun, moon, and eleven stars made obeisance to him. By the "eleven stars" is here meant the eleven constellations, for it is thought that the ancients would, in the first instance, name the constellations of the Zodiac after the principal stars in each, and these stars, and the portion of the ecliptic assigned to them, may have been noticed before the stars around them were grouped into constellations. In any case the introduction of the Zodiac into Greece seems to have been subsequent to that of the celestial sphere. Moreover, they do not seem to have received it complete, as it had only eleven constellations, one of them—the Scorpion—having been divided since to complete the number. Perhaps in this may be found the explanation of the number eleven in Joseph's dream; or, it may be that it was customary among the Egyptians to leave out one of the twelve when used symbolically. Indeed, we have evidence of this in the fact, that on the lid of a mummy coffin, found not long ago, was painted a goddess, and over her body the signs of the Zodiac, with that of *Capricorn* left out, perhaps in this way indicating the month or season of the year when the person departed. An attempt has also been made to trace some reference to the twelve signs in the blessing pronounced by Jacob on his sons—as, for example, Judah is said to be a lion; Dan a serpent; Joseph, whose bow abode in strength, the archer; Dinah, Jacob's only daughter, is the virgin, etc. But however this may be, there is no doubt of the fact that the four chief tribes bore on their standards each a sign of the Zodiac; that of Judah being a lion, Ephraim a bull, Dan a scorpion, and Reuben a man. It is well known that the Egyptians worshipped the signs of the Zodiac, the Ram being consecrated to Jupiter Ammon, who was represented with the head and horns of a ram. The Bull became the god Apis, while the Twins correspond to Horus and Hypocrates, the two sons of Osiris. The Capricorn was consecrated to Pan or Mendes, while the Water-bearer is found on many Egyptian monuments. Nor is it difficult to understand why both this and the Bull should be their most popular deities, considering how serviceable to them was the river Nile on the one hand, and the bull on the other, in promoting their agricultural operations. It is well known that they had also great feasts in honour of their Zodiacal deities. Lucian, an ancient writer, says:—"It is from the division of the Zodiac that the crowd of animals worshipped in Egypt had their origin. Some employed one constellation and some another; those who used to consult that of the Ram, came to adore a ram; those who took presages from the Fishes, would not eat fish; the goat was not killed in places where they observed *Capricornus*; and so on, according to the stars whose influence they most prized."

Thus, we see how it was that the Hebrews under Moses were so strictly forbidden to worship the host of heaven, or even to make an image or representation of anything in the heavens, or in the earth, or in the waters under the earth. Various nations were in the practice of engraving the signs of the Zodiac on their coinage, and from these ancient relics alone much information has been obtained of the astronomy of the ancients. The Chinese were in the habit of so doing; but the animals chosen to represent the signs are very different from those of the Chaldeans, Greeks, and Egyptians. They were the Bull, the Hare, the Tiger, the Dragon, the Serpent, the Horse, the Ram, the Monkey, the Cock, the Dog, and the Pig. The Chinese claim to have derived their astronomy from Fo-hi, who is supposed to be the same with Noah, he having returned, along with his sons, to the north-eastern part of Asia about the dispersion of Babel, and to him they attribute the invention of the Zodiac.

Having already noticed the "leader Ram, all bright with golden wool," by following the course of the ecliptic a little farther to the left, we come upon

"The mighty Bull,
Whose back parts first appear,"

which is the next in order of the twelve Zodiacal constellations. (See *Dia. X.*) It is easily recognised by that remarkable and well-defined cluster of minute stars known as the Seven Stars, or *Pleiades*, which form the "back parts" of the Bull. A little farther to the east, and lower down, is another small cluster called the *Hyades*. This forms the head of the Bull, the large red star *Aldebaran* being the eye; while still farther to the left, but higher up in the direction of *Capella*, are two stars which represent the tips of his horns. Pretty big horns they are, too, though no doubt, being a bull of celestial breed, it was to be expected that he should be largely developed in this direction, seeing that in olden times the horn was the symbol of power. Perhaps the reader may have some difficulty in tracing such an animal in the diagram, but in this respect he is not one whit behind ourselves. It has been said that the eye brings with it the power to see, but we are inclined to think that the ancients brought the thing to be seen as well. A young friend of ours having seen the diagram of the Plough, and having had her attention drawn afterwards to the constellation itself, exclaimed, "My! it's real like the picture." Even so, the people of the olden time imagined they saw in the constellations the real likeness of the pictures they had in their minds. Among country people the *Pleiades* are known as the seven weeping sisters, while they ascribe the fact of there only being six stars visible in the cluster, to one of them having wandered and become lost, leaving those that remain to weep and mourn her loss. Now, so far from there being only six of these, at least 200 can be seen through the telescope.

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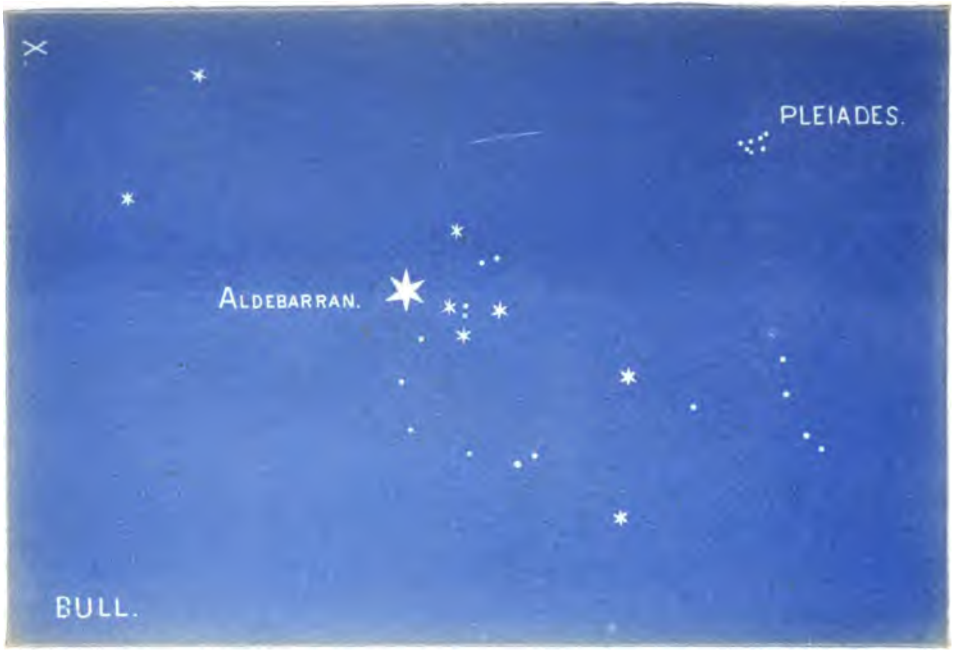

X.
PLEIADES.
ALDEBARRAN.
BULL.

According to mythology the *Pleiades* take their name from Pleione, the wife of Atlas, King of Mauritania, to whom she had seven daughters. These princesses suffered no little persecution during their life-time, first from Busiris, King of Egypt, and latterly from Orion the Giant, who pursued them for five years, till Jove being prevailed upon by their prayers, took them up into heaven, where they still shine as a good example to all young damsels who prefer to walk in the paths of virtue. Their individual names are Maia, Electra, Taggeti, Asterope, Halcyone, and Celeano. As a constellation they were the terror of mariners of the olden time, as being the cause of the rain and storms that prevail in certain latitudes about the season when they rise. There is a certain myth in connection with the other group, the *Hyades*, which form the head of the Bull. They, too, were the daughters of Pleione and Atlas, but their brother, Hyas, being torn to pieces by a lioness, they so mourned his death that the gods had compassion on them, and translated them to heaven.

Of all the groups of stars familiar to the children of men the Pleiades seems to have awakened the greatest amount of interest—an interest that may be said to be almost universal—and that from the fact that, lying near to the celestial equator, they are seen during a portion of the year by the inhabitants of both hemispheres. Northern constellations such as the Great Bear are never seen by those on the other side of the world, and for the same reason we on the northern side of the equator never see such constellations as the *Southern Cross.* But the *Pleiades*, owing to their equatorial position, can be seen by all nations of the earth during some portion of the year. Then the fact of their rising at one season and setting at another caused them to be looked upon as strikingly eventful, on which account great feasts were held at such periods as their rising and culmination. In our latitude they make their first appearance in the evening about the beginning of September. Indeed, they may even be seen early in August, but in that case they must be looked for long after midnight. We saw them for the first time this season at midnight on the 15th August; but the *Hyades*, being lower down, we did not see till about two in the morning. Other interesting particulars in connection with the *Pleiades* we reserve for another chapter.

CHAPTER V.

Position of the Constellations in January—*Orion*—The Pleiades, their importance to the Ancients—The Pleiadic Year—The Pleiadic Festivals: Traces of in India and Egypt, among the Jews and ancient Druids, in Mexico and Australia—The Great Central Sun of our Universe.

WHEN the first of these papers appeared the fields were waving with the ripening harvest, the trees were majestically bending their leafy banners to the breeze, richly emblazoned with the gold and emerald of autumn; birds were yet singing amid the branches, while happy children were gleefully shouting at their out-door games. Since then a mighty change has passed over the face of nature; all things now wear the dreary aspect of winter. The trees stand stripped of their foliage like masts denuded of their sails. In field or by wayside not a solitary wild-flower lifts its head. The howl of the tempest through the leafless wood has hushed alike the song of the bird and the gleeful laughter of the little ones; in short, everything we look upon but serves to remind us of the fleeting nature of terrestrial joys and pleasures. But when we look up into the azure vault of the winter sky, how great, how unspeakably grand is the contrast! Here the splendours of creation are unvarying, "the same yesterday, to-day, and for ever." Here we behold the constellations on their glorious march round the ecliptic,

"For ever singing as they shine,
The hand that made us is divine."

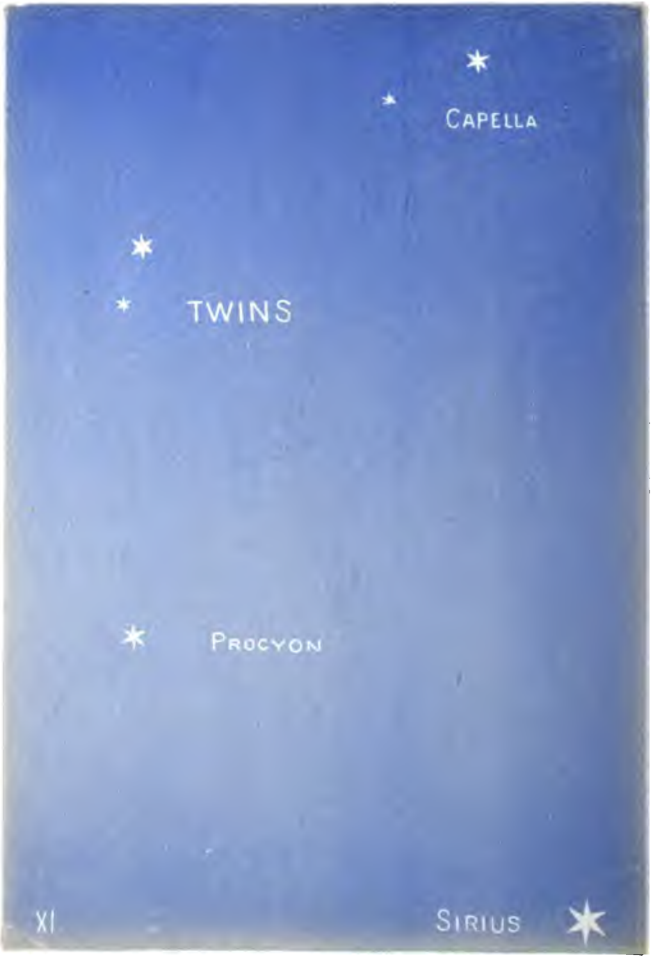
The month of January, perhaps, surpasses all the other months of the year in its celestial scenery, on which account it ought to be dear to the student of nature, and to those whose attention is not wholly engrossed by the pursuits of business; while even to *these*, engaged as they are in the hurry and worry of the world, the splendid, yet placid aspect of the heavens at this season presents a pleasing contrast that brings with it a soothing sense of rest and of stability, of which they stand greatly in need.

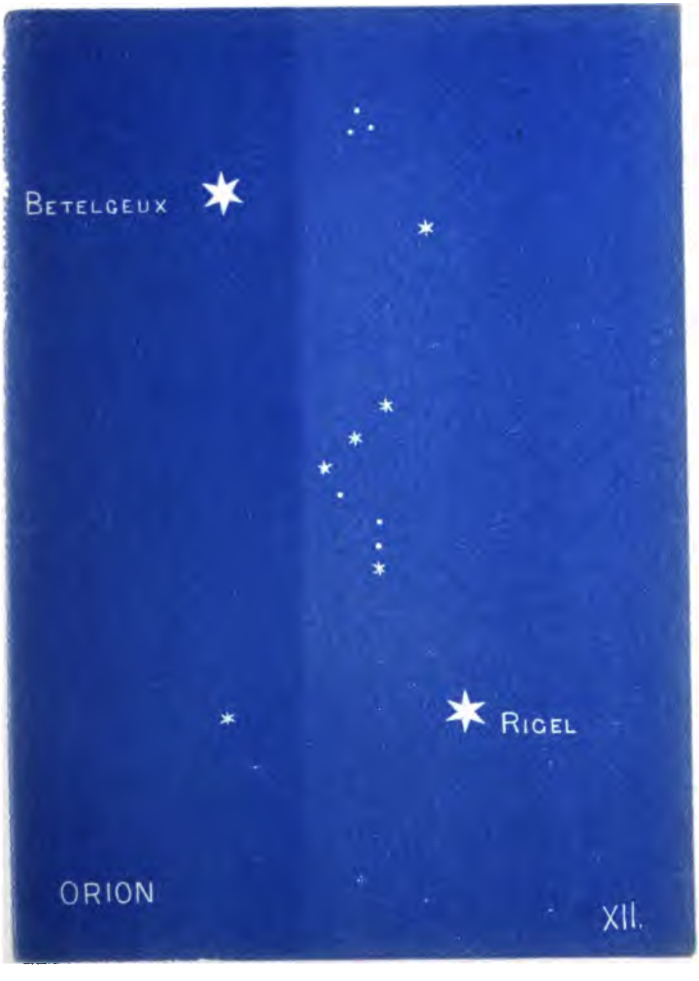
But before proceeding to describe the constellations that have risen from beneath the eastern horizon since our last survey, and now unite to form the glorious spectacle we have referred to, let us note the progress that has been made by those constellations with which we are already familar. The Milky Way, which in November stretched across the centre of the firmament from east to west, now lies in the direction of from south-east to north-west; the forked or divided portion which was then about midway betwixt the zenith and the horizon, being now much nearer to the latter, *Cygnus* or the Swan, which occupies the point where it begins to branch, is low down in the north-west, while the bright star *Vega* is very near to the horizon. This star, though on the very edge of the horizon, does not set, but continues to move eastwards, keeping close to its verge till the end of March, when it begins once more to ascend the blue arch from the north, on its journey eastwards. *Boötes* is now due north, and all beneath the horizon but his two upper stars, so that *Arcturus*, in all his glory, we will not see at nine o'clock P.M. till about the middle of next month, when he will make his debut from the east. Even now, however, he may be seen as a *morning* star shining in the east. *Perseus* is now in the zenith overhead, *Andromeda* about midway betwixt that and the western·horizon, while still farther to the west *Pegasus* is close to it, so close that his nose may be said to be touching it. A line drawn from this point to the zenith, and continued thence to the point opposite on the eastern horizon, would thread the following constellations: —*Pegasus*, *Andromeda*, *Perseus*, *Auriga*, *Gemini*, while a slight bend to the north would also take in *Leo* the Lion, whose head is now making its appearance above the north-eastern horizon in the form of a sickle. From the same point on the western horizon, if we follow round the curve of the ecliptic, we will have within our ken no less than six of the constellations of the Zodiac. First, we have the Fishes just under the nose of *Pegasus*, then the Ram, then the Bull, next the Crab, with its small and indistinct cluster, *Presepe*, then the Twins, and lastly, the head of *Leo;* while, if the watcher wishes to behold a few more of these constellations at the same sitting, he may do so by continuing till dawn, by which time he will have added to his list *Virgo*, *Libra*, and *Scorpio*. The other three, viz., *Sagittarius*, *Capricornus*, and *Aquarius*, being under the horizon, will not rise till after the sun, whose light prevents their being seen during the day, and but for which all the twelve constellations of the Zodiac would be seen during one rotation of the earth upon its axis.

Taurus the Bull, with which we left off in our last chapter, is now in the south, about midway betwixt the horizon and the zenith, and close to the meridian, while about the same level, but more to the east, may now be seen *Gemini*, with its bright twin-stars *Castor* and *Pollux*, the former being a star of the first magnitude, the latter of the second. Standing as we now are with our face to the south-east, our line of vision will be right along the Milky Way, while on our right, and near to the horizon, we behold *Sirius*, the brightest, and by far the most beautiful, star in the heavens. It forms the chief orb and ornament of the constellation *Canis Major*, or the Great Dog; hence *Sirius* is also called the Dog-star. On the same side of the Milky Way—namely, the right, and occupying the space between the constellation last named and the Bull—we come upon *Orion*, perhaps the most picturesque constellation in the heavens. It is easily known by the three bright stars in a line which form *Orion's* belt, and alluded to in the book of Job as the "bands of Orion." They are also familiarly known as the "Ell-wand," "King's Ell," "Three Kings," "Jacob's Staff," etc. Its form and position will at once be understood from *Diagram XII.* A line drawn from the Pole-star through *Capella* leads down to *Orion*, *Capella* being about half-way.

On figured charts of the constellations *Orion* is represented as a giant brandishing a formidable club in his right hand, whilst from his left arm hangs a wild beast's skin. Of the four stars forming the oblong, or trapezium, the two upper are his shoulders, the small stars above being his head; while of the two lower, the one to the left forms his right knee, the one to the right being his left foot. *Betelgeux*, in his right shoulder, and *Rigel* in his left foot, are stars of the first magnitude, and of a blood-red colour. The three stars which cross the figure in an oblique direction, form, as we have already said, his belt, while the other three stars which hang straight down from it represent his sword. Here it may be useful to know that the line of the celestial equator which divides the two hemispheres passes close beneath the upper star of the "belt," so that all the stars on the lower side of that line may be said to belong to the southern hemisphere, on which account we only see them during a part of the year.

Orion is the richest of all the constellations in bright stars, two of them being of the first magnitude. *Rigel*, in the left foot, is a very beautiful double star, and composed of a white and a blue sun. Two other binary systems are met with in


CAPELLA
TWINS
PROCYON
XI
SIRIUS


BETELGEUX
RIGEL
ORION
XII.

the stars forming the extremities of the belt; the one to the right consists of a white and purple sun, and the other to the left, of a yellow and blue sun. Besides these, there is in the Great Nebula of the Giant's Sword—to be referred to in a subsequent chapter—a star which, when divided by a powerful telescope, presents no less than six suns to our admiring gaze.

The left of this grand star-picture is made up by the constellations *Canis Minor*, *Gemini*, and *Auriga*, which are on the opposite side of the Milky Way. Of *Canis Minor*, or the Lesser Dog, the principal star is *Procyon*, literally the forerunner of the Dog. It is a very beautiful star of the first magnitude. It forms an obtuse angle with *Castor* in the Twins, and *Sirius* in *Canis Major*. A line drawn through the three stars forming the belt of *Orion* in a downward direction will pass through *Sirius*, while upwards it will pass through the *Pleiades* above *Aldebarran*. *(Diagram XI.)*

And here we are reminded that we have still a few particulars to communicate in reference to this constellation, which may be found not a little interesting to some of our readers. When the sun is to the east of the *Pleiades*, we cannot see them, for they have already set. So that in viewing the heavens after sunset we would not see them, nor can we, so long as the sun is to the east of them, which is nearly half-a-year. During the other half of the year, the sun being to the west of the *Pleiades*, they become visible after sunset. In this way the ancients were led to divide the year into two portions, one of which might be called the *Pleiades below*, and the other the *Pleiades above*. We learn from Hesiod, that the Greeks commenced their winter in his days by the setting of the *Pleiades* in the morning, and the season of summer by their rising at that time. Besides such direct evidence, we find that many semi-annual festivals connected with these stars indicate the commencement of the two seasons among other nations. A New Year's festival determined by or connected with the *Pleiades* appears to be one of the most universal of all customs. The actual observance at this present day of such festivals is to be found among the savages of Australia.* At the midnight culmination of this cluster of stars in November, which is with them the beginning of spring, they still hold what is called the new year *corroboree* in honour of *Mormodellick*, as they call the *Pleiades*, which they say "are very good to the black fellows." In the northern hemisphere the culmination of the *Pleiades* is more related to the autumnal equinox, which would never be taken for the commencement of the year, so that the custom must have originated with some of the earlier races of the southern hemisphere. In India, the year commenced in the month they called *Cartiguay*, which means the *Pleiades*. The name of the *Pleiades* with the Chaldeans and Hebrews is *Athar-aye;* while Athyr is the Egyptian name for November. Moreover, they call the constellation *Atauria*, from which we have the word *Taurus*, the Latin for Bull. It would also seem that these festivals held at the rising or culmination of the *Pleiades* were held not only as the beginning of a new year or cycle, but in commemoration of the dead; and there is evidence that they had some connection with the Deluge.* On the 7th day of November is celebrated the Hindoo Durga, a festival of the dead; while among the ancient Egyptians, on this day, commenced the solemn festival of Isis, which lasted three days. The commemoration of the dead among the Egyptians was connected with the Deluge, and was typified by the priest placing the image of Osiris in a sacred coffer or ark, and launching it into the sea that it might be borne off by the waves. Connecting this fact and that of the celebration taking place on the 17th day of the month Athyr, with the date on which the Mosaic account of the Deluge states it to have commenced, "in the second month (of the Jewish year, which corresponds to November), the 17th day of the month," it must be acknowledged that this is no chance coincidence, and that the precise date here stated must have been regulated by the *Pleiades*, as was that of the Egyptians. At the great annual religious festival, held by the Jews in the beginning of September, it is, or was, the custom of the women of that persuasion to mingle with the worshippers dressed in grave clothes, yet we know that the worship of the dead had no place in the Jewish creed.

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* We have just learned that not long ago the last of the natives of Australia passed away.

"The 1st of November," says the author already referred to, "was with the Druids (our ancient progenitors) a night full of mystery, in which they annually celebrated the reconstruction of the world. A terrible rite was connected with this, for the Druidess nuns were obliged at this time to pull down and rebuild each year the roof of their temple as a symbol of the destruction and renovation of the world. If one of them, in bringing the materials for the new roof, let fall her sacred burden, she was lost. Her companions, seized with a fanatic transport, rushed upon her, and tore her to pieces; and scarcely a year is said to have passed without there being one or more victims. On this same night the Druids extinguished the sacred fire, which was kept continually burning in the sacred precincts, and at that signal all the fires in the island were one by one put out, and a primitive night reigned throughout the land. Then passed along to the west the phantoms of those who had died during the preceding year, and were carried away by boats to the judgment-seat of the god of the dead." "Although," continues our author, "Druidism is now extinct, the relics of it remain to this day, for in our calendar we still find November 1st marked as All Saints' Day, and in the pre-Reformation calendars the last day of October was marked All Hallow Eve, and the 2nd of November as All Souls'; indicating clearly a three days' festival of the dead, commencing in the evening, and regulated by the *Pleiades*."

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* For the most of the particulars we have given in connection with the Zodiac and the *Pleiades* we are deeply indebted to a work by John F. Blake, entitled "Myths of Astronomy," based upon the French work of Flammarion, entitled "The History of the Heavens."

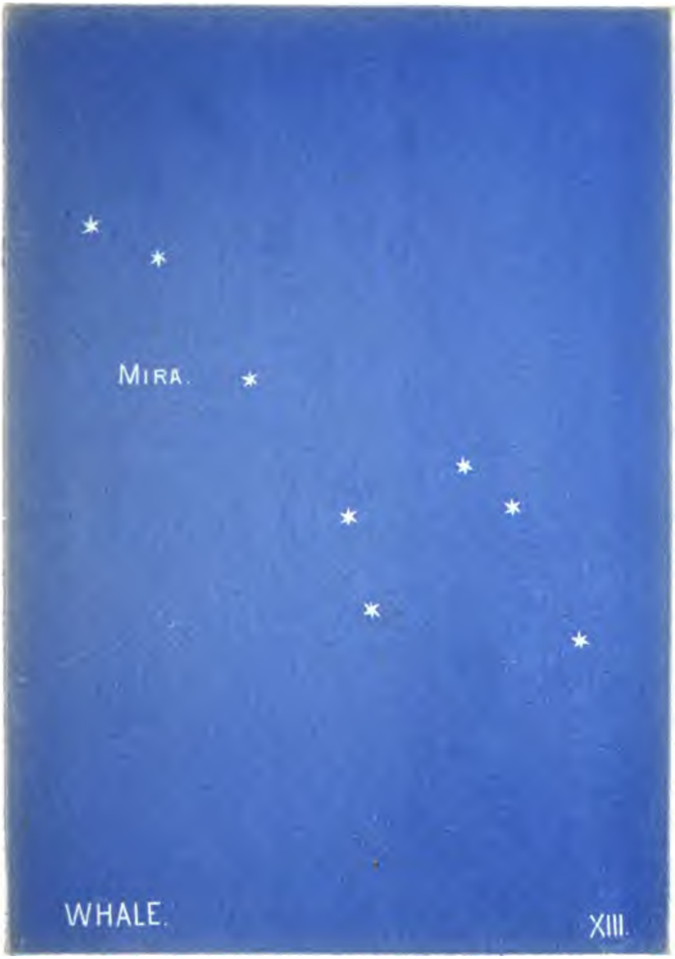
In the above extract possibly we may have some clue to the mixed rites of our own Scottish Hallowe'en, the performance of some of which were supposed to have the power of summoning the spirits of the dead, or the absent from the vasty deep. Among the ancient Mexicans a great festival was held at the culmination of the *Pleiades*; it began at sunset, and at midnight, as the constellation approached the zenith, a human victim was offered up to avert the dread calamity which they believed overhung the human race. In Borneo the natives are guided by this constellation in their farming operations; when it is declining towards the west in the morning it is time to plant, and when it does so in the early evening, then they may reap in safety and in peace. We find similar rules among the ancient Greeks, in the days of Hesiod, who tells us that the corn is to be cut when the *Pleiades* rise, and ploughing is to be done when they set; also that they are invisible for forty days.

From all this, then, it will be seen how universal was the importance attached to this constellation by the races of man-

CHAPTER VI.

February—Farther Alterations in the Positions of the Constellations—***Mira*** or the Wonderful Star—Appearance of *Leo* in the East—Re-appearance of *Arcturus*—Bernice's Hair—*Cor Caroli*—Difference of Position of the Constellations at different hours: how caused—The Grand Star-picture of the Year—*Castor* and *Pollux*—*Sirius*, or the Dog-star: Historical Associations—The Great Nebula in the Sword of *Orion*—Other Universes—Dream of the German Poet.

SINCE our last survey of the starry canopy, the constellations therein referred to have shifted their positions a considerable way to the west. *Aldebarran*, and the *Pleiades*, which were then on the meridian, are now about midway in their downward course to the western horizon; while their place on the meridian is now occupied by the Twins and the bright star *Procyon*, in the Lesser Dog. Following in the wake of *Taurus*, but lower down, we still behold the splendid constellation of *Orion;* while still lower, and a little to the left, *Sirius*, the Dog-star, is shining in all his matchless glory and splendour. About the same distance above the horizon, but much farther to the west may still be seen the constellation of *Cetus*, or the Whale. (See *Dia. XIII.)* This we need hardly remind our readers, is the great sea monster, from which, according to mythology, the fair Andromeda was delivered by the valiant Perseus. The two principal stars are of the second magnitude. *Menkar* is situated in the mouth of the monster, and *Mira*, or the Wonderful Star, in the neck. The latter receives its name from the fact that like *Algol* in the head of the *Medusa*, it varies periodically in size and lustre. It was first discovered by David Fabricius in 1596, at which time it appeared as a star of the third magnitude, but disappeared after the month of October in the same year. It was again observed by Holwarda in the year 1637; and after having disappeared during a period of nine months it again became visible; since which time it has been found pretty regular in its period, except from October, 1672, to December, 1676, during which time Hevelius could not perceive it, though it was a particular object of his attention. According to modern astronomers it remains at its greatest brightness about a fortnight, being then nearly equal to a star of the second magnitude; it decreases during three months till it becomes completely invisible, in


MIRA.
WHALE.
XIII.

which state it remains about five months, when it becomes visible, and continues increasing during the remaining three months of its period. From the diagram our readers will see that this constellation is not "very like a whale," but more resembling an easy chair with a sloping back. It is now just about to disappear beneath the south-western horizon, and will not be again visible till the end of September, when it will make its appearance in the east. It lies just below *Aries*, and may be found by a line drawn from *Caph*, the right hand star in *Cassiopeia*, passing through the two stars forming the left hand side of the Great Square of *Pegasus*; this, if continued, will pass through *Menkar* in the head of the Whale. The bright star *Capella* is still high up in the zenith, but more to the west, while *Vega* is away down upon the verge of the horizon to the north. In the east, and just rising above the horizon, may now be seen, in all its well defined completeness and splendour, the constellation of *Leo*, or the Lion; thus adding another to the grand panoramic procession of the Zodiac. This constellation belongs specially to the season of spring, and remains visible till the end of July. In the long ago it set at the beginning of the month, then the sun was said to be in the sign *Leo;* but, as we have already shown, owing to the precession of the equinoxes, it has fallen behind a whole sign, so that the sun does not really pass into *Leo* till August. Of all the constellations bearing the names of animals, *Leo* perhaps is the nearest approach to the form of the animal whose name it bears. (See *Dia. XIV.*)

Leo is easily distinguished by the sickle-like curve which represents the head of the animal; the bright star *Regulus*, or *Car Leonis*, forming the handle of the sickle, as well as the heart of the lion. When it makes its appearance in January the Great Bear is stretching across the sky from north to south, while *Leo* occupies a position parallel to it, but lower down, and a little more to the south, consequently a line drawn in continuation with the two stars forming the left hand side of the square of the Plough will pass through the bright star *Regulus* in *Leo.* In the space betwixt *Leo* and *Ursa Major* are one or two small constellations, but so indistinct that they are not easily traced by the unaided eye, as *Leo Minor*, the Little Lion, *Coma Bernices*, or Bernice's Hair, and *Canes Venatici*, or the Huntsman's Dogs, the huntsman being *Boötes*, the Bear-driver. One star in the Dogs is easily distinguished on a clear night; it is known as *Cor Caroli*, or the Heart of Charles; it appears as a solitary star just a little below the last star in the Bear's tail. Bernice's Hair, or Bernice's Wig, as it is sometimes facetiously styled, requires a clear night and a clear pair of eyes to see it; it has a wavy and hair-like appearance. It owes its name to Bernice, an Egyptian princess, who, according to the story, was noted for her beautiful hair. This she cut off and placed it in the Temple of Venus as a thank-offering for the safe return of her husband from the war; but afterwards being lost, the court astronomers consoled her by the assurance that her beautiful locks had been turned into a constellation.

It will not be out of place here to remark that something depends on at what hour of the night we make our observations, in order to see the constellations in the positions we have indicated, seeing that a star which is on the meridian at say nine o'clock will, if viewed at six o'clock, only have reached a point about mid-way betwixt the east point and the meridian; whereas, if we make our observation at twelve midnight, it will have advanced to a point mid-way between the meridian and the west. This turning round of the whole firmament, as we have already shown, is not real, but only apparent; the real movement being that of the earth turning upon its axis towards the east, thus causing the constellations to appear as if passing to the west. But besides this, it will be observed by the young star-gazer that the stars do not occupy the same position when viewed at the same hour each evening throughout the year, but always a little in advance of the position they occupied on the previous night. If the earth simply spun round on her axis without altering her position, as in the case of a spinning top when it is said to be "sleeping," we would in that case find the stars night after night in exactly the same spot at any given hour; but the earth, while thus turning on her axis, is also moving along her orbit round the sun, on which account the stars that passed the meridian last night at, say, nine o'clock will to-night pass it about *four minutes* earlier. This is because the earth is moving round to meet the stars. By way of illustration, let us say that a horse gallops round a race-course in fifteen minutes, so long as it holds on at the same rate of speed, it will pass the winning post at the quarter hour, but move the winning post in the direction of the advancing steed, and the latter will reach it earlier than if it had not been moved. Just in the same way stars pass the meridian earlier on each successive night because the earth is bowling along her orbit to meet them.

We are the more anxious to make this matter clear, because we find that it is the chief stumbling-block in the way of beginners. We remember when we ourselves began to take an interest in the constellations, how dumbfoundered we were to find the constellations we had seen in a certain part of the sky on the night previous, all gone next morning, and their places occupied by others that were less familiar to us. The Great Bear and the other circumpolar groups were still to be seen, but how altered their positions! His Bearship whom we saw on the night previous standing on the tip of his tail, would now be standing on his head on the opposite side of the circle. But by and by, when we came to understand the two motions we have referred to, and particularly as described in our first chapter, our difficulties were removed.

But of all the scenes presented by the grand stellar panorama of the firmament, the crowning picture is still that formed by the Twins, *Orion*, *Taurus*, and *Sirius*, the Great Dog. *Orion* is now almost due south, and standing erect in all his glory and beauty. When first seen at the end of autumn, his figure is reclining in the direction of the north, while in the spring, just before setting in the west, it will be found to lean in the opposite direction. So also the Twins, when they make their appearance in the east, stand in a vertical position, but as they move round to the west, they gradually bend over, till at last they are nearly horizontal. This grand star-picture is the more striking from the fact, that the constellations of which it is made up contain many bright stars both of the first and second magnitudes. First, at the top of the picture we have the constellation *Auriga,* with the bright and sparkling *Capella;* to the left, and a little lower down, the beautiful twin luminaries, *Castor* and *Pollux;* directly beneath which is the large bright star *Procyon* in *Canis Minor.* An oblique line drawn from this to the bottom of the picture will lead us to the brightest, and by far the most splendid of them all, *Sirius.* From *Sirius,* imagine another oblique line up towards the right of the picture, and it will be found to run along *Orion's* belt to *Aldebarran* and the *Pleiades.*

Castor and Pollux, according to the ancient myths, were the sons of Jupiter; while others suppose them to have been called after the sons of Ledi and Tyndarus, King of Lacedemon.

Their sister was the famous Helen of Troy. They are said to have done good service during their terrestrial career, by clearing the Grecian waters of pirates, on which account they were held in great veneration by sailors. In the 28th chap. of Acts we find that the ship in which the Apostle Paul and his shipwrecked companions left the island of Melita had for its sign or figurehead the effigies of *Castor* and *Pollux*. *Sirius*, the largest and brightest of all the stars, is the chief star and ornament in *Canis Major*, or the Great Dog. Some idea may be formed of the prodigious magnitude of this star when we are told that it exceeds our sun by 2,668 times, while our sun is itself 1,260,000 times larger than the earth. What is called the Canicular Year is dated from the rising of this star in the morning just before the sun, hence called its *Heliacal* rising. Its rising was by the ancients supposed to be the occasion of the extreme heat, and the diseases incident to this season. The *Dies Canicularis*, or Dog Days, were forty in number, twenty before and twenty after the rising of the star. The time of its rising depends on the latitude of the place, and is later every year in all latitudes, owing to the precession of the equinoxes; so that in time it will rise in the depth of winter. This star seems to have been intimately connected with Egypt, and to have derived its name as well as that of the constellation from that country. The overflowing of the Nile was always preceded by an Etesian wind, blowing from north to south about the time of the passing of the sun beneath the stars of the Crab, which drove the mists to the south, and accumulated them over the country whence the Nile takes its rise, causing abundant rain, and hence the overflow of that river. Great importance was attached to the foretelling the time of the event, so that people might be prepared with provisions and places of safety from the flood. The rising of *Sirius* in the morning was a sure precursor of the inundation, hence it was looked upon as the warning star, by whose first appearance they were to be ready to remove to places of security, thus acting the part of a faithful dog, whence they gave it the name of the Dog or Monitor, in Egyptian *Anibis*, in Phenician *Hanobeack*. From certain photographic experiments it has been inferred that the intrinsic light of *Sirius* is sixty-three times that of the sun. How great then must be its magnitude and distance! Sir William Herschel tells us that at one time sweeping the heavens with his monster instrument, "The appearance of *Sirius* announced itself at a great distance, like the dawn of morning, and came on by degrees, increasing in brightness till this brilliant star entered the field of the telescope with all the splendour of the rising sun, and forced me to take my eye from the beautiful sight."

Orion, as we have said, is crossed by the line of the celestial equator, and is consequently, like the *Pleiades*, seen by all the inhabitants of the globe. Among the ancients he was a gigantic hunter, and the same with Orus, Arion, the Minotaur, and Nimrod, the mighty hunter of holy writ. He was reputed to be the handsomest man in the world. So immense was his size that when he waded through the deepest seas he was still a head and shoulders above the waters, and when he walked on the dry land his head touched the clouds. He was the son of Hyrieus, a cattle herd of Bœotia, to whom Jupiter gave him as a reward for his hospitality to strangers. He lived a wild and adventurous life, and perished at last by an arrow, or, as some say, by the bolt of Zeus. After his death he was placed with his hound among the stars, where with the skin of a wild beast on his arm he reigns, the most splendid constellation in the heavens. Here we are very forcibly reminded of Longfellow's beautiful poem, the "Occultation of Orion," and can hardly resist the temptation to insert the following:—

" Sirius was rising in the east:
And slow ascending, one by one,
The kindling constellations shone.
Begirt with many a blazing star
Stood the great Giant Algebar,
Orion, hunter of the beast!
His sword hung gleaming by his side,
And, on his arm, the lion's hide
Scattered across the midnight air
The golden radiance of its hair.
The moon was pallid, but not faint;
Yet beautiful as some fair saint
Serenely moving on her way
In hours of trial and dismay.

" As if she heard the voice of God,
Unharmed with naked feet she trod
Upon the hot and burning stars,
As on the glowing coals and bars
That were to prove her strength and try
Her holiness and her purity;
Thus moving on with silent pace,
And triumph in her sweet, mild face,

a sleepy film; by unutterable pace the light swept to them, they by unutterable pace to the light. In a moment the rushing of planets was upon them, in a moment the blazing of suns.

"Then came eternities of twilight that were revealed, but were not revealed. On the right hand and on the left towered mighty constellations, that by self-repetitions and answers from afar, that by counter positions, built-up triumphal gates, whose architraves, whose archways, horizontal, upright, rested, rose at altitude by spans that seemed ghostly from infinitude. Without measure were the architraves, past number were the archways, beyond memory the gates. Within were stairs that scaled the eternities below; above was below, below was above, to the man stripped of gravitating body; depth was swallowed up in height insurmountable, height was swallowed up in depth unfathomable. Suddenly, as thus they rode from infinite to infinite, suddenly, as thus they tilted over abyssmal worlds, a mighty cry arose, that systems more mysterious, that worlds more billowy, other heights and other depths, were coming, were nearing, were at hand.

"Then the man sighed, and stopped, and shuddered, and wept. His overladened heart uttered itself in tears, and he said, 'Angel, I will go no farther, for the spirit of man acheth with this infinity. Insufferable is the glory of God. Let me lie down in the grave and hide me from the persecution of the infinite; for end, I see, there is none.' And from all the listening stars that shone around issued a choral voice, 'The man speaks truly; and there is none that ever yet we heard of!' 'End is there none?' the angel solemnly demanded. 'Is there, indeed, no end? and is this the sorrow that kills you?' But no voice answered, that he might answer himself. Then the angel threw up his glorious hands to the heaven of heavens, saying—'End there is none to the universe of God. Lo! also there is no beginning.'"

CHAPTER VII.

The Constellations in March—The Astronomy of the Ancients—Supposed Solidity of the Celestial Vault—Sphere within Sphere—The Earth the Centre of the Universe—Alphonso, the Astronomer King.

OUR readers will remember how, in our first chapter, we compared the celestial sphere to an immense umbrella, and how we endeavoured to illustrate its apparent nightly revolution by supposing said umbrella to have a staff, or axis, long enough to reach from the observer to the Pole-star. Held in this position said staff would, we further remarked, fitly represent the supposed axis or spindle on which our globe revolves. But in that case the staff would have to be detached from the umbrella and thrust right through the centre of the earth, and that without altering its relative position to the Pole-star. So that if we wish to illustrate the apparent movement of the starry canopy, we have only to turn the handle of our great umbrella; while, if we wish to illustrate the real movement, or that of the earth upon its axis, we disconnect the handle from the expanded part above and connect it with the earth below, and with this common article of convenience we may illustrate in the simplest manner either the daily rotation of the earth on its axis, or the apparent revolution of the heavens around the Pole-star. But besides this daily rotation of the earth upon its axis, by which we are enabled to view night after night the same well-marked constellations, we have also to take into account the no less evident fact of its revolution in its orbit, or path around the sun, which it performs in a period of twelve months, some odd hours, minutes, and seconds.

Now, the stars being stationary, and the earth continually on the move, it naturally follows, as we have already said, that we do not find the constellations exactly in the same position night after night at any given hour, but always a little in advance of the old position; consequently, now that six months have elapsed since we commenced, those of our readers who took note of the positions of the constellations at that time (September) will now find that the various constellations which surround the polar centre have changed places with each other. The Great Bear which was then to the north-west of the Pole-star is now to the south-east of it, being the place then occupied by *Cassiopeia*. In the same way *Vega*, which was then to the south-west of the Pole-star, and near to the zenith, is now low down near to the horizon in the north-east, the place then occupied by the bright star *Capella*. Then, we had the other members of the Cassiopeian family—*Pegasus*, *Perseus*, and *Andromeda*—occupying prominent positions in the east, now they are far down in the west, the first mentioned already beneath the horizon. At that time, occupying the arch of the ecliptic from the extreme east to the opposite point in the west, we had the following constellations of the Zodiac, the Bull, the Ram, and the Fishes, to the east of the meridian; while to the west might be seen the Water-carrier, the Goat, and the Archer. Of these the three last have gone down in the west, while the three first are following in their wake, and now nearing the horizon. Meanwhile we have the Twins on the meridian, *Virgo* just rising above the horizon in the east, and *Leo* now occupying a very prominent position betwixt the two former. The figure and position of *Virgo*, or the Virgin, may be easily traced in the heavens by the help of *Diagram XV.*

As will be seen it resembles in form the letter **y**; its principal star *Spica*, or the ear of corn, is of the first magnitude, and forms the tail-end of the figure, the open part being towards the star *Denebola*, in the tail of *Leo*. This cup-shaped opening, formed by five of its stars, was by the ancients of Arabia called "The Retreat of the Howling Dog." From this it would seem that they must in their minds have associated with the constellation some other object besides a virgin. *Spica*, the largest and brightest star of the constellation, being at the tail-end of the figure, and at a considerable distance from the others, was, on account of its solitary splendour, called by the Arabs the "unarmed (or defenceless) *Simak*." Like the bright star *Capella* it is of a bluish colour.

Our old friend *Arcturus*, who has been absent from our evening sky for the last three months, may now be seen beaming gloriously in the east. The Northern Crown, too, has also just risen, after a similar interval of absence; while the Cross in the *Swan* is just touching the northern horizon, having now reached the lowest point in its course. Just setting in the south-west there is one constellation, which we ought to have noticed earlier, namely, *Eridanus*, or the River. Its name is very appropriate, seeing that it is a long and somewhat winding constellation, reaching from the bright star *Rigel*, in the left knee of *Orion*, away round in a westerly direction towards *Cetus*, where it turns down to the south, thence bends round to the east in the direction of *Sirius*. It is this, that is alluded to in Longfellow's beautiful poem, already quoted, as "the river at his feet," into which the wild-beast's skin drops from the arms of the giant when

> "The reign of violence is o'er."

Beneath the feet of the giant *Orion* is a small constellation

[illegible] in the west, we had the following constellation [illegible], the B[illegible], the F[illegible] the Fishes, to the east of [illegible] while to the west might be seen the W[illegible] [illegible] Goat, and the Archer. Of these the three [illegible] in the west, while the three first are follow[illegible] [illegible], and now nearing the horizon. Meanwhile [illegible] on the meridian, [illegible] just rising above the [illegible], and [illegible] now occupying a very prominent [illegible] two former. The figure and position of [illegible] the Virgin may be easily traced in the heavens [illegible]

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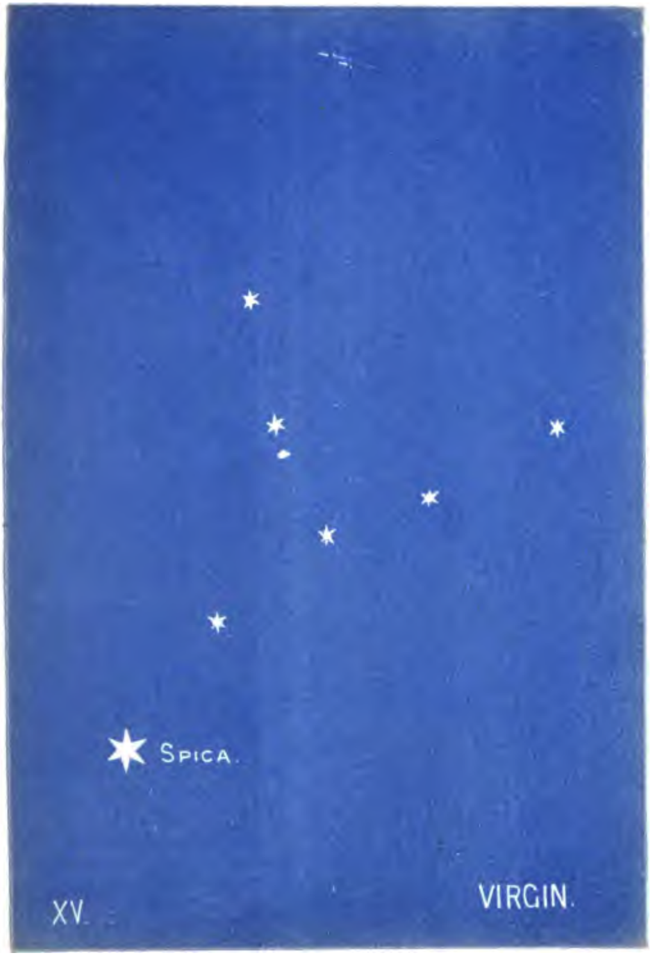
"The reign of violence is o'er."

Beneath the [illegible] of the giant *Orion* is a small constellation


Spica.
XV.
VIRGIN.

called *Leporis*, or the Hare; while to the east of *Sirius*, and a little lower down, may be seen the upper stars of the constellation *Argo*, or the Ship. These stars, which may be said to represent the masts, are all that we can see of this constellation, seeing that it belongs to the southern hemisphere. It received its name from the ship, Argo, in which, according to mythology, Jason and his companions sailed in the expedition to recover the golden fleece. Its position in relation to the southern polar centre is similar to that of the Great Bear to the northern. And just as the latter moves around the Pole-star without setting, even so the former sails around the south polar centre. But though we from our latitude can see the top of her masts, those living in the same latitude south cannot see even the tip of *Ursa Major's* tail. Passing round still further to the east in the direction of *Leo*, there is one star that is worthy of notice, from the fact that the stars in its neighbourhood are so indistinct that it seems as if standing alone. This is *Cor Hydrae*, the Heart of the Sea Serpent, to which the Arabian astronomers gave the name of *Al Ford*, or the Solitary One. About midway betwixt this and *Virgo* is the star *Alkes*, the chief star in the small constellation *Crater*, or the Cup.

Mr. R. A. Proctor who has studied this subject, in all its branches, is of the opinion that the constellations in this quarter of the heavens, including *Aquarius*, *Cetus*, *Corvus*, *Eridanus*, *Argo*, *Ara* the Altar, and *Centaurus*, are in some way connected with the Noachian deluge, and that these figures painted inside the doors of ancient temples, in some way represented the events of the narrative; as for example, *Argo*, the Ship, might represent the Ark; *Eridanus*, the Water; while *Corvus*, which is sitting on the back of *Hydra*, the Sea Monster, may represent the raven that left the ark and did not return thither. *Centaurus* was originally a man offering sacrifice upon *Ara* the Altar, while above is a mass of small stars which might represent a cloud. In this star-cloud is located *Canopus*, the principal star in the bow,—in other words, the bow in the clouds.*

Having wound up our two last chapters with some of the grand and glorious results of modern astronomical science, it will be something of a relief to the mind, as well as a useful and much-needed lesson to us, to consider for a little, by way of contrast, the crude and fanciful theories held by the ancients of the universe and its phenomena. "When I was a child I thought as a child," said the great Apostle of the Gentiles; even so, in the childhood of our race, men could only conceive childish ideas of the phenomena of the universe, and particularly those of the celestial sphere. From the earliest ages down to times comparatively recent, this little insignificant planet on which we are located was the all in all of God's universe to its inhabitants. The sun, moon, and stars were simply lights set in a crystalline shell or firmament to give us light, just as lamps are fixed in the roofs of railway carriages for the convenience of the passengers.

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* See "Flowers of The Sky," By R. A. Proctor.

This great sphere of solid crystal was made to revolve on two pivots—the one south, and the other north—which were its poles. This theory of the solidity of the sky was supported by all the ancient philosophers, and seems to have been founded on the fact that a body cannot remain in space without some material support; and being totally ignorant of the great fact of a universal law of gravitation, by which the heavenly bodies are linked together as if by invisible cords, they were in a manner compelled to believe in the existence of a solid supporting roof, which in revolving carried all the heavenly orbs with it. By and by, however, this simple theory failed to give satisfaction to thoughtful observers of the celestial phenomena; they began to see that the movements of the sun, moon, and stars did not coincide with those of the fixed stars; so to account for these they supposed there must be a number of crystalline spheres placed one within the other, like the coats of an onion, but apart and distinct, so as to move independently of each other.

Some idea of these spheres as believed in by the ancients may be gathered from the following extract from Cicero:—"The universe is composed of nine circles, or rather of nine moving globes. The outermost sphere is that of the heavens, which surrounds all the others, and on which are fixed the stars. Beneath this revolve seven other globes, carried round by a motion in a direction contrary to that of the heavens. On the first circle revolves the star which men call Saturn; on the second Jupiter shines, that beneficent and propitious star to human eyes; then follows Mars, ruddy and awful. Below, and occupying the middle region, revolves the sun, the chief prince and moderator of the other stars, the soul of the world, whose immense globe spreads its light through space. After him come, like two companions, Venus and Mercury. Lastly, the lowest globe is occupied by the moon, which borrows its light from the star of day. Below the last celestial circle there is nothing but what is mortal and curruptible except the souls given by a beneficent Divinity to the race of men. Above the moon all is eternal. The earth situated in the centre of the world, and separated from heaven on all sides, forms the ninth sphere; it remains immovable, and all heavy bodies are drawn to it by their own weight."

Added to this, the earth was supposed to be surrounded by the sphere of air, and above that by one of fire. But even these arrangements failed to account for the variety and eccentric movements of the heavenly bodies in space, and so one philosopher after another kept adding to them, till in some of the later systems they were as many as seventy-seven spheres, including what was called the *Primum Mobile*, and the sphere inhabited by the angels, above which was the throne of Deity fixed, and eternal. Such a number of spheres, with their cycles and epicycles, was both cumbersome and perplexing, so much so that the astronomer-king, as he was called, Alphonso X., of Castile, exclaimed in a full assembly of bishops, that if the Deity had done him the honour to ask his advice before creating the world, he could have shown him how to make it a little better, or at all events, more simply. This theory of the immobility and central position of the earth, with its surrounding spheres, cycles, and epicycles, received the support —and was on that account the more firmly established—of the church fathers; and it was deemed blasphemy and heresy to dissent from it, or to teach the opposite view.

Ages before that which gave birth to Copernicus, we find indications that a few among the learned held the theory that the earth moved round the sun. Three centuries before the birth of Christ, Aristarchus of Samos is said by Aristotle to have composed a special work to defend the motion of the earth against the contrary opinions of philosophers. In that work he says, "the sun remains immovable, and the earth moves round it in a circular curve, of which that star (the sun) is the centre." For so teaching Aristarchus was persecuted by the authorities of his time, being accused of irreligion and of troubling the repose of Vesta. To this matter Plutarch refers, The system of the ancients found its fullest embodiment in the famous system of Ptolemy, who was in his day looked up to as the greatest authority in Astronomy. But at last, in the 15th century, a genius was given to the world destined to give the death-blow to that erroneous system that had outlived fourteen centuries. This genius was the great Copernicus, who gave to the world the true exposition of the system of the universe. "Why do we hesitate," wrote Copernicus, "to give to the earth the mobility suitable to its form, rather than that the universe, whose bounds we do not and cannot know, should revolve? Why should we not confess that the diurnal revolution is apparent only in the heavens, and real in the earth? since, while the ship glides tranquilly along, all external objects appear to the sailors to move in proportion as their vessel moves, and they alone, and what is with them, seem to be at rest."

Having in his perusal of the old writers received hints of the real nature of the celestial movements, and struck with the simplicity apparent in all the works and operations of Nature, Copernicus was not long in coming to the conclusion that the complicated system of Ptolemy could not be a true representation of the universe. The poet Milton well expresses the difficulty presented to the mind of the great astronomer in the following lines:—

"When I behold this goodly frame, this world
Of heaven and earth consisting, and compute
Their magnitudes; this earth, a spot, a grain,
An atom, with the firmament compared
And all her number'd stars, that seem to roll
Spaces incomprehensible (for such
Their distance argues, and their swift return
Diurnal) merely to officiate light
Round this opaceous earth, this punctual spot,
One day and night; in all their vast survey
Useless besides; reasoning I oft admire
How nature, wise and frugal, could commit
Such disproportions, with superfluous hand
So many nobler bodies to create,
Greater so manifold, to this one use,
For aught appears, and on their orbs impose
Such restless revolution day by day
Repeated, while the sedentary earth,
That better might with far less compass move,
Served by more noble than herself,
Attains her end without least motion."

Great was the opposition given to the new system by the philosophers and men of science of that day, and still greater by the church, which has ever shown itself the most conservative, not to say intolerant, of institutions, and has in all ages opposed the advancement of science, branded its votaries as heretics and infidels, and its investigations as sacrilege. Indeed, so rampant was this spirit in the time of Copernicus that his famous work which gave embodiment to his system, and that system to the world, was not published till his death; yet on his deathbed, it is gratifying to know that the old philosopher had the pleasure of reading the proof sheets. No doubt this opposition on the part of the church to astronomical research was considerably strengthed by the fact that astronomy had been much mixed up with the religion of Paganism. In various ways they tried to counteract this, as, for example, in the eighth century, Bede and certain other theologians and astronomers thought to depose the Olympian gods by giving new names to the constellations. They put St. Peter in the place of the Ram, St. Andrew instead of the Bull, and so on; while, in more recent calendars, David, Solomon, the Magi, and other New and Old Testament characters were substituted for the older and more familiar names, but these changes were never generally adopted.

But it was not till a century later that the Copernican system was fully confirmed, and that when Galileo finished the first telescope available for scientific purposes. But the good service done by Galileo in favour of the new system was more in connection with the laws of motion than of astronomical discovery. "It was alleged," says an author already quoted, "by the opponents of the doctrine of the earth's rotation, that if the hypothesis were true a stone dropped from the summit of a high tower would not fall at the base, as we see it does; for during the few seconds required for its descent the tower itself would be carried through an arc of several hundred feet, owing to the earth's velocity, and the stone be left far behind before it reached the ground. In a similar manner it was argued that birds upon the wing would find the landscapes over which they hovered pass away from under them, which would be equally true of an arrow shot, or a stone thrown into the air. Galileo unanswerably showed that a projected body partakes of the motion of the projector, so that the stone, the birds, and the arrow, with the entire atmosphere round the earth, participate in the common progress of the whole mass." What this apostle of science suffered in the way of persecution we all know, but truth being stronger than error, must eventually gain the victory. And now we find that instead of our planet being the grand centre of the universe, to minister to which all the other heavenly orbs were created, she is in comparison with some of these far away globes but as a grain of sand to a mountain—that she is but a small and insignificant member of the family of planets circling round and depending upon the sun, while that sun is but one—and not a large one—of the myriad stars that twinkle in our midnight sky.

In reference to other phenomena connected with the science of astronomy, the ancients held even more absurd and ridiculous notions. Among others was that of Anaxagoras, that the heavenly bodies were fragments of rocks which the ether, by its circular motion, had detached from the earth, set fire to, and turned into stars. Curious, and no less absurd, ideas were also held of the nature of the Milky-Way. By some it was considered as marking the course taken by the sun at the beginning of the world; by others it was the remains of the conflagration kindled by Phaeton when he took in hand to drive the chariot of the sun. Still worse was that of Theophrastus, who said it was the junction betwixt the two hemispheres, which together form the vault of heaven, and that it was so badly done that it let through some of the light that he supposed to exist everywhere beyond the solid sky. According to Plutarch, Xenophenes, who flourished 360 years before Christ, held the opinion that the stars were lighted every night and extinguished every morning; that the sun is a fiery cloud; that eclipses take place by the sun being extinguished, and afterwards being rekindled; that the moon is inhabited, but that she is eighteen times larger than the earth; that there are several suns and several moons for giving light to different countries.

Now we know that the Milky-Way is a vast agglomeration of suns, and in itself but one of the many nebulæ that loom dimly from the impenetrable depths of space; that it is but one of a mass of sidereal systems, and our own sun but a single star in this immense archipelago of more than eighteen million orbs. By the Chinese and Arabians the Milky-Way was called the "River of Heaven;" by the Greeks, the "Galaxy," while it is the "Path of Souls" among the North American Indians.

No less crude and limited were their ideas of the distance of the heavenly bodies. The Egyptians came to the conclusion that the planet Saturn was only distant from the earth 492 miles, the Sun only 369, and the Moon 246 miles. Hesiod, again, thinks to give a grand idea of the size of the universe by saying that Vulcan's anvil took seven days to fall from heaven to earth, when in reality, as has been calculated, it would take a cannon ball, moving at the rate of five hundred miles an hour, 14,250,418 years to traverse the interval betwixt us and the nearest star. But as we have already said, the human race was then but in its childhood, and could only conceive childish ideas of the universe.

CHAPTER IX.

The Position of the Constellations in May—Close of the Celestial Summer—Mystery of the Stellar Universe—Our own Solar System the Key to the Mystery—The Sun and his Family—Planetary Globes: their Origin and History—The Nebular Theory.

Our planet having now reached a point in its annual course where its northern half receives a plentiful supply of the sun's life-giving force in the shape of light and heat, thereby setting in operation those powers and processes by which she is clothed anew with vernal life and beauty, it is not to be expected that those who have accompanied us thus far in our starry wanderings, should continue to take the same interest in the subject.

The beautiful season of summer having now arrived, our facilities for watching the constellations in their imposing midnight march over the heavens are greatly lessened, and that chiefly owing to the fact of the extreme length of the day, and corresponding shortness of the night. Only the enthusiastic few will care to sit up till midnight in order to trace out some particular star or constellation visible at this season of the year. Besides, we must confess, that old as we are, we feel rising within us all the ardour of boyhood to wander away once more into the fields and meadows, the glens, the woods, and the waysides, that we may hold sweet communion with the beautiful children of Flora, and gather into our vasculum her dewy treasures. Meanwhile, though silent on the subject of the constellations, we do not intend to bring this interesting theme to a close till, by the light of modern discovery, we are able to show that the countless stars of our galaxy are not merely twinkling points of light, but immense masses of incandescent matter, similar to our own sun, many of them far exceeding that luminary in size and brightness; moreover, that the stars exist for the express purpose of supplying life-supporting energy to the planetary worlds, over which they have control. But ere we enter upon this interesting subject, let us have at least one more look at those constellations with which we have been made familiar.

The Great Bear being to the south of the Pole-star, is now in full possession of the zenith or point overhead, consequently the southern region of the sky—extending from the zenith to the southern horizon, is now occupied with the constellations which more particularly belong to the Plough quarter. As we have already said, the constellations belonging to the *Capella* quarter present the grandest star picture of the year; but that of the Plough or *Ursa Major*, undoubtedly comes next. In the zenith, we have the Great Bear, with his tail curving round to the south; following in the direction of its curve, we reach the bright star, *Arcturus* in the constellation of *Boötes*, or the Bear-driver; a little farther round, and we come upon *Spica*, in the Virgin, while *Leo* completes the curve, and brings us round to the forepaws of the Bear. Inside the circle we have the solitary *Cor Caroli*, Bernice's Hair and *Leo Minor*. Outside this limited circle, and farther down in the south, we have *Corvus*, the Crow, sitting on the back, as it were, of *Hydra*, or the great Sea Serpent; to the east of this *Libra*, or the Balance; and just rising out of the east the red star *Antares*, in the constellation of *Scorpio*, or the Scorpion,—so that, of the zodiacal constellations now in view we have *Gemini* and *Leo* in the west, *Virgo* and *Libra* in the south, and *Scorpio* and *Sagittarius* in the east; but the two last will not be well seen till the end of the month, and even then not till after midnight.

Antares, like *Aldebarran* and *Betelgeux*, is a red star. This ruddiness of tint is supposed by physicists to indicate a decline of temperature and brightness. It would appear, however, that the stars are subject to frequent changes of colour. If we go back to ancient records, we read that *Sirius*, which is now green, was red; that *Capella*, which is now pale blue, was also red. *Antares* will not appear above the southern horizon before the 20th May.

As those of our readers who have followed us thus far in our

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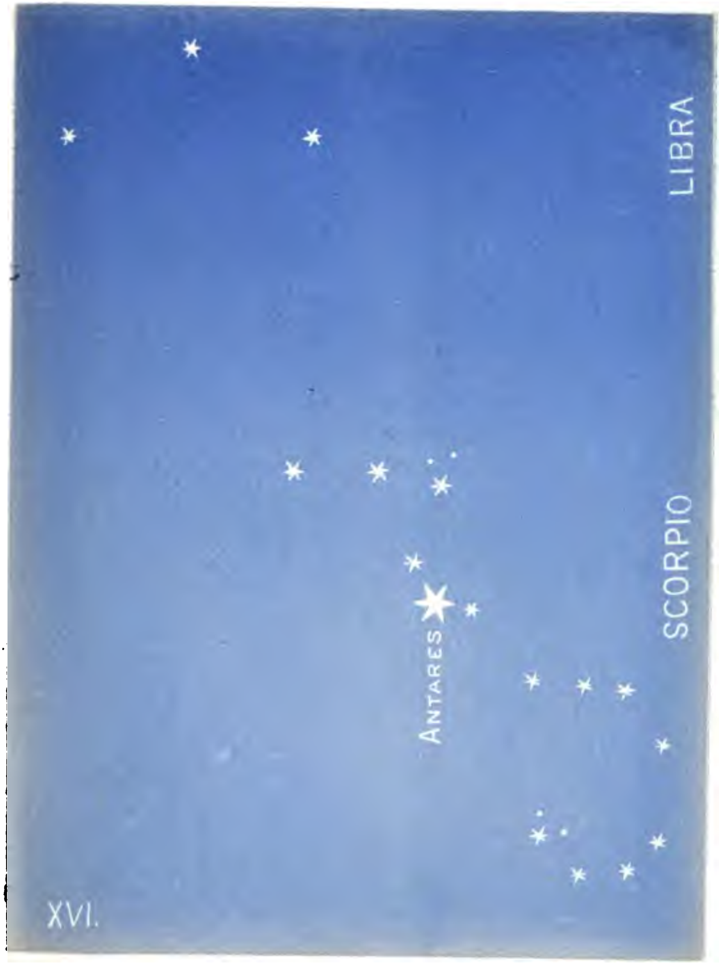
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ANTARES
XVI.

explorations of the starry firmament will now be sufficiently acquainted with the more conspicuous constellations to note their changes of position for themselves, we need not pursue this part of our subject further; and as we have no doubt but that some of these have found the subject sufficiently interesting to awaken the desire to learn something of the probable constitution and uses of those immense globes which people the realms of space, we now proceed to consider briefly this very important part of our subject. That the stars which light up with varying splendour the depths of space are immense globes emitting light and heat to planetary bodies around them, even as our own sun acts upon his planetary system, our most advanced astronomers do not harbour a doubt. And the question as to whether such globes and their attendant orbs are the abodes of vegetable, animal, and intellectual life can only be answered by the analogies presented by our own sun and the planets dependent upon him, in so far as these have been made known to us; and this brings us to the more immediate question—Are the other planets belonging to our system the abodes of life such as we behold it on our own? And here we would remark that it is not to be expected, except in the case of those nearest to us, that the other members of the solar system should present those conditions which would render them fit to support creatures similar to those on earth, and the more so when we consider the vast difference that obtains among them in respect to distance from the sun. One astronomer says—"Supposing we wished to make a chart of the solar system, we would take a globe some two feet in diameter, which we would place in the centre to represent the sun. To represent Mercury, the nearest planet to the sun, we would lay down a grain of mustard seed about eight feet distant from the latter. Venus would be represented by a pea, about 142 feet distant; Earth, another pea, at a distance of 215 feet; Mars, a rather large pin's head, at 327 feet distance; the asteroids by grains of sand, from 500 to 600 feet; Jupiter, the largest orb in the solar system, would be represented by a moderate-sized orange, at a distance of half a mile; Saturn, a small orange, about three-fifths of a mile; Uranus, a small plum, distant three-quarters of a mile, or rather more; and Neptune a good-sized plum, distant about one mile and a quarter."

Corresponding with these differences in sizes and distances from the central luminary must also be those of light, heat, and length of years as we shall see by and by. Nor must we here overlook the fact that even our own planet was for untold ages in a condition altogether unfit for the support of life, even of the lowest type. So that looking at the subject from this point of view, we may expect to find the larger planets quite unfit to be the abodes of living creatures, seeing that the larger the mass of a planet the longer time will it take to cool so as to be habitable.

According to the nebular theory, which is the one now generally accepted by scientific men, our sun and his family of planets, moons, meteors, comets, etc., must at one time have been one vastly diffused mass of incandescent vapour or fire-mist. This vast nebula revolving upon itself would, in the process of condensing and contracting throughout the entire mass, throw off or leave behind rings which, subject to the same forces, continued to contract till they took the form of spheres. These, in their turn, would leave or throw off similar rings, which in time would become moons or satellites. Moreover, in support of this theory of the formation of the solar system, astronomers point to the fact that the planet Saturn is still surrounded by a number of such rings, in which changes are going on quite in keeping with the theory; so that, in course of time, Saturn may have ten or a dozen moons instead of eight. Of the great solar nebula by far the greater portion of it yet remains in its original condition, and that portion, we need hardly say, is the sun. Even yet it is an orb of vast dimensions, its diameter being 853,380 miles.

CHAPTER X.

More about the Sun—Sun-Spots, their Nature and Origin, extent, duration, and periodical increase and decrease—The Photosphere, its Chemical Constitution—Spectrum Analysis.

HAVING entered upon the study of the solar system, it will all the better enable us to understand it if we have, to begin with, a clear comprehension of that mighty engine by which its machinery is driven, the sun. Besides, the sun himself being a star, and the only one of which we may be said to know anything, some knowledge of his condition and phenomena will serve as a key to the nature and constitution of those distant orbs which appear as mere points of light in our midnight skies.

To give his readers some idea of the immense size of the sun, Mr. R. A. Proctor, in his "Other Worlds than Ours," calculates that—given, a globe large enough to fill a room twenty-six feet square, to represent the sun, the earth would be represented by one of three inches in diameter. Or say that the globe of the sun were large enough to fill the whole extent of the blue vault above us—and which it certainly would if brought near enough—the earth would appear as a round black spot on the middle of it, about the size of the moon as we see it with the naked eye. It will also help us to form some idea of the distance of our great luminary to know that a railway train starting from earth, at say the present time, 1881, would not, though going at its greatest speed, reach the surface of the sun before the middle of the year 2191.

While in bulk, the sun is 1,200,000 times greater than the earth, it would only require 300,000 earths to counter-weigh the former, owing to the fact that the matter of which it is composed is less solid than that of the earth. Like the latter, and the rest of the planets, the sun rotates upon his axis, and that once in every fourteen days, so that the solar day—if we may so call it—is fourteen times the length of ours. This was ascertained through watching the passage of sun-spots across the solar disc, with their re-appearance on the opposite side. Among the ancients the solar orb was thought to be immaculate, and even though a spot did sometimes appear to the unaided eye long before the invention of the telescope, it was looked upon as being miraculously sent as a sign or portent of some impending calamity. And even when, after the invention of the telescope, such spots were ascertained to be of regular occurrence, they were stoutly denied by the more orthodox, and set down to the imperfections of the instrument, or the imagination of the observer. Among the first to ascertain the true nature of these spots on the sun, was our fellow-townsman, Dr. Wilson, of Glasgow, in the year 1773. He maintained that the sun is an opaque mass surrounded by a luminous atmosphere, and that the spots are excavations or openings in this luminous envelope, by means of which the observer is able to see the dark body of the sun himself. Sun-spots indicate great commotion and violent changes in the solar envelope or photosphere, extending over tens of thousands of square miles. Besides these dark spots there are also bright spots or ridges of light termed *faculae*, these often surround the dark spots and unite with each other to form a kind of net-work. But even the smoother or spotless portion of the sun's surface presents through the telescope a corrugated apppearance.

From the continual changes taking place in the photosphere there can be no doubt but that it is of a cloudy character; but unlike the clouds that envelope our earth, they are not composed of water, but of various substances, chiefly metals reduced to vapour by intense heat. Sometimes, however, sun-spots are due to layers of these gases pressing one upon the other, so as to obstruct or absorb the light. On the other hand, when these clouds are at their highest, the light is at its brightest. It has been found too that sun-spots are periodical in their appearance and activity, some of them cover thousands of miles of the sun's surface, and retain their form and dimensions for months, while others are only of short duration and can only be seen through the highest powers of the telescope.* The number of the spots also vary at different times, so that astronomers reckon a minimum period when none are visible for weeks or months, and also a maximum period when more are seen than at any other time; the interval between two maximum, or minimum periods, being about eleven years. On this account astronomers look upon our own sun as a variable star, just as they look upon *Mira* in the Whale, or *Algol* in *Perseus*. Most astronomers are also of the opinion that sun-spots are in some way connected with the revolution of the planets in their orbits, and more particularly when in their perihelion passage—that is, when at that part of their orbits which is nearest to the sun. At the present time no less than three of the larger planets are nearing their perihelion—namely, Jupiter, Saturn, and Neptune, and on this account it is expected that changes of an exceptional character may take place in the photosphere of the sun that may possibly affect our seasons; while, on the other hand, the more superstitious, fostered by sensational articles in newspapers and religious periodicals of the penny-a-week class, are looking forward to the advent of times of calamity pregnant with wars, pestilence, and famine. The winter just passed, as we all know, has been one of the severest on record, while on the opposite side of the globe we learn that the people there have not experienced such a hot summer for the last twenty years; but whether these extremes of temperature have anything to do with the approaching perihelion of the planets it is difficult to determine.

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* Here we would warn the young student of astronomy of the danger of looking at the sun—even through the smallest telescope—without a darkened eye-piece to the instrument, as total blindness, or permanently impaired vision, might otherwise be the result.

It is only within recent years that astronomers have been able to learn anything of the physical constitution of the sun, and this has been accomplished by means of that wonderful instrument, the spectroscope. Most people are familiar with the effect produced by a prism of glass when placed betwixt a ray of light and a dark room, when the ray of light in its passage through the prism is divided into a band of colours which is thrown upon the dark back-ground. In connection with this it has been found that light, passing through the vapour of metallic substances, alters or modifies the arrangement of colours in the spectrum, and that each metal gives its own particular spectrum. It is then, on this principle, that the light passing through the cloudy envelope of the sun has been analysed, and the result is that a number of substances have been found in it which are common to the globe on which we dwell. The following is a list of the gaseous substances thus found—

Sodium,
Iron,
Magnesium,
Barium,
Copper,
Nickel,
Zinc,
Calcium,
Chromium,
Hydrogen,
Titanium,
Cobalt,
and
Manganese.

Of these gaseous substances, the highest in the photosphere in point of position, is hydrogen, it being the lightest of all gases; the others occupy positions lower down according to their weight. No heat with which we are acquainted on earth is sufficiently powerful to reduce iron to a state of incandescent vapour, consequently the heat present in the sun must be very great. According to Mr. J. Norman Lockyer, the heat thrown off from every square yard of the sun's surface is as great as that which would be produced by burning six tons of coals on creatures? that a tiny globe like earth should swarm with life like an over-ripe cheese, while other planets belonging to our system, and far surpassing it in dimensions, are but vast deserts of death? To such an unwarrantable supposition analogy emphatically answers, No! As one eminent astronomer has well said, "Until it has been demonstrated that no form of life can exist upon a planet, the presumption must be that it is inhabited." It was also a favourite axiom of Sir William Herschel, that there can be no safer guide to a knowledge of what we do not know than the knowledge of known facts.

Christianus Huygens in his "Cosmotheros," published in our own city in 1757, illustrates his argument for analogy as follows,—"If any one should be present at the dissection of a dog, and be there shown the entrails, the heart, stomach, liver, lungs, and guts, all the veins, arteries, and nerves; could such a man reasonably doubt whether there were the same contexture and variety of parts in a bullock, hog, or any other beast, though he had never chanced to see the like opening of them?"

The Bible tells us that a rib was taken from the side of our first progenitor in order to supply him with a partner on whom to lavish his abounding affection and life-energy; and science only repeats the story when it tells us that the planets were one after another evolved from the mass of the sun, and that these, through the process of cooling and consequent condensation, became changed from their original condition of *positivity* to that of *receptivity;* in other words, they became receptacles for the light and heat of the parent orb, and so in time became fitted to bring forth and maintain the living and moving vegetable and animal kingdoms.

Nor have we the slightest doubt but that He who is the eternal source of being, the fountain of all life, and love, wisdom, and power, finds supreme delight in ministering to the myriad intelligences He has evolved from Himself; while they in their turn find their happiness in basking in the light of His countenance, and in continually receiving the most tangible tokens of His love and favour.

But, in order still farther to unlock the mysteries of the stellar universe, let us now proceed to examine and consider the facts that have been revealed in connection with the solar system, beginning with our own beautiful planet Earth, which forms our only reliable guide and key to a knowledge of the nature and condition of the others.

CHAPTER XI.

The Planet Earth: its Phenomena, Cosmical History, and Constitution.

For thousands of years mankind have watched the movements of the heavenly bodies and admired their serene and sparkling beauty all through the silent hours of the night, but it was not until comparatively recent times that they became aware of the fact that the world on which we are located is a member of the bright solar family. Placed as we are on a globe of such magnitude, it is not easy to realise this, seeing that to the eye of the observer it does not appear as a globe, but as an extended plane; but looking at it in the light of certain ascertained facts, and by a slight exercise of the imagination, it will not be difficult to realise it as it must appear to the inhabitants of, say, the planet Venus, if such there be. As seen from the surface of that planet, our earth will appear a resplendent object in a cloudless night-sky; while from Mars we could, through a telescope, watch her passing through her phases, just as we see the moon. Now it would be at the full, anon half in shadow, then as a silver crescent; while at long intervals we could see it as a small dark spot crossing the glowing disc of the sun.

From the different geological features of the earth's crust it has been calculated that one hundred million years must have elapsed during its formation. Such, at least, is the estimate formed by Crowe, and accepted by Sir Charles Lyell. From experiments by Bischoff, it is calculated that while the earth was cooling from a temperature of two thousand to two hundred degrees, about three hundred and fifty millions of years must have elapsed. But prior to this there was a long period of time when the earth was in a nebulous condition, so that a fair estimate of our world's age may, it is thought, be placed at five hundred million years.

Around its thickest part the earth measures nearly twenty-five thousand miles, while its cubical bulk contains two hundred and sixty billions of cubic miles. Its mean diameter amounts to about seven thousand nine hundred and twelve miles, and its superficial area to two hundred millions of square miles. The same amount of matter if piled on the surface of England and Wales would form a column of more than four million miles in height, with a summit equal to its base in thickness. The mean density of the earth is reckoned at rather more than five and a half times that of water, hence the earth would counter-weigh a globe of ironstone of the same dimensions. The entire weight of our globe is estimated at more than six thousand millions of tons. And yet this ponderous mass, without the aid of any machinery, internally or externally, revolves upon its axis once in every twenty-four hours, less four minutes, while at the same time it is rushing through space at the rate of sixty-five thousand miles an hour, a swiftness to which that of a cannon ball is insignificant; bearing on its continually revolving surface cities, temples, smoke-enveloped towns and picturesque villages, its mountains and hills, its sparkling streams and peacefully-flowing rivers, its billowy seas and oceans, its woods and forests, its green pastures and browsing cattle, its myriads of animal and vegetable life, and its restless millions of humanity. How strange to think that all are being hurried through space with such fearful rapidity, yet withal so smoothly and silently that only a few of the more intelligent of mankind are conscious of the fact. We stand aghast when we hear of a railway collision causing great destruction of life and property, but one can scarcely imagine the amount of ruin and disaster that would be likely to occur were the earth brought suddenly to a standstill. The highest mountains would be at once hurled into the valleys; cities and towns would be laid in ruins; in some localities the sea would overflow the land, while in others its bed would be left dry. But the most marked result would be that the motion of the earth thus suddenly arrested would be converted into heat, and it would thus become one glowing mass of incandescence, while to the inhabitants of Mars or Venus it would appear as a flaming red star moving in the glare of its own lurid light. But nowhere in the solar system can we detect the slightest sign that would lead us to apprehend any such catastrophe; on the contrary, all its motions evince the most perfect adjustment and regularity.

Perhaps no better example could be found of the wisdom and beneficence of the Being whose hand guides the machinery of the Universe, than that of the simple means adopted to produce a change of seasons all over the earth's surface, and upon which the inhabitants of earth so much depend for the enjoyment of life. This, as we have elsewhere stated, is effected by a slight bending of the earth's axis from the perpendicular—

amounting to 23 degrees. This, taken along with the fact that no matter on what part of its course the earth may be, the poles keep steadily pointing north and south. The result of this is that the northern and southern ends of the earth are brought alternately under the direct influence of the sun, so that when it is summer in the northern hemisphere, it is winter in the southern, and *vice versa;* for when it is winter with us, it is summer with the inhabitants of Australia and New Zealand. Not that we are farther away from the sun in winter, but simply that his rays fall aslant upon the end of the earth that is *turned away* from him. For the same reason the sun is hid from us in winter during more than two-thirds of the 24 hours, setting, at the shortest day, about 23 minutes past 3 P.M., nor rising again till 34 minutes past 8 A.M. We are about three million miles nearer to the sun in winter than in summer. This is owing to the fact that the path of the earth around the sun is not circular, but slightly oval, while the sun is not in the centre of the oval, but nearer to the one end. On this account the disc of the sun appears larger to us in winter, and but for this our winters would in all likelihood be much colder than they are.

So far as we know at present, the earth is made up of 64 elementary substances, existing in the air, the water, and its solid crust. Of these 49 are metals, and 15 metaloids or non-metals. Four of these are found in the air in the form of gases, 30 in the waters of the sea, and the rest in the earth's crust. Oxygen is found in combination with almost every solid, as well as with water, constituting about one-half of the solid crust of the globe. The bulk of the earth's crust consists chiefly of about eight of these elements, viz., oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, and potassium. Next to oxygen in its plenity of distribution is silicon, which greatly makes up the constitution of rocks; while aluminium in combination with oxygen supplies the clay of which most soils chiefly consist. Iron comes next, and then calcium, which enters largely into the compositions of limestone rocks; and so on with the rest. Another very important element of the non-metallic class is carbon; important because it enters into the constitution and structure of all vegetable and animal existences, and but for which earth would be one vast desert, without a tree or shrub or living thing to beautify and enliven its surface. Reference has been made to these well known substances because a number of them are found to exist in the luminous envelope, not only of the sun, but in the far distant stars, and in the comets and meteorites of the solar system; thus indicating the common origin and material constitution of all worlds.

The lightest, as well as the most exterior portion of the earth, is the atmosphere, which is composed chiefly of the two gases, oxygen and nitrogen. Lower down, and still heavier, we have the clouds and waters of the ocean; next, and yet heavier, the rocks and soils forming the crust of the earth, but even these are more than one-half lighter than the earth as a whole, thus leading us to the conclusion that the central part of the earth must be composed of materials much greater in weight and solidity than those at its surface. Now if this law prevails throughout the whole of the solar system, it must necessarily follow that those planets that are nearest to the sun must be much more dense than those that are farther away. But ere we proceed to elucidate and consider the character and condition of the other planets, it might be as well that we devote a page or so to the examination of our own satellite, the Moon.

CHAPTER XII.

The Moon: what the Telescope reveals concerning it—Absence of Water or Atmosphere—Its Phases and other Phenomena explained—Popular Fallacies concerning it.

Ever since it became known that the Moon and Planets are worlds similar to our own in constitution, the all-important question in regard to them has been,—Are they, like our own world, furnished with races of animals and plants,—more particularly, with intelligent beings, similar to ourselves? Taking analogy for our guide in the inquiry, the answer will altogether depend on whether the same or similar conditions prevail in such worlds. According to analogy, then, we are very naturally led to think, that of all the bodies composing the family of the sun, our own fair satellite, the moon, would be the most likely to reveal signs of life on its surface, seeing that it is a dependent of our earth, originally (as is supposed) a part of it, and consequently identical with it in its physical character and constitution—an island, as it were, quite close to our own shores, and forming at one time an integral part of the mainland. We had thus grounds for supposing—not only that it would be clothed with vegetation, and abound with animal existence—but that such existences would be identical with those of the parent orb. But, alas for our expectations! the all-piercing eye of the telescope scatters all our poetic dreams; for when viewed through that instrument, the moon presents to the eye—not a picture of life and beauty—but a scene of death-stricken desolation, the very wreck and ruin of a world. Its surface, like that of our own world, is diversified with hill and valley, mountain and plain, mountains, for the most part, rising to altitudes exceeding the highest peaks of the Himalayan range. Some of these rise in cone-shaped masses from the midst of circular abysses, so deep and dark that the sunlight cannot pierce them. Great level plains too there are upon its surface, and of such extent as to suggest the thought that they may be the beds of ancient seas. All over the surface of the moon can be traced the sure signs of volcanic action in the form of extinct craters and erupted rocks, but nothing of woods or waters; not even the smallest patch of green to indicate the presence of vegetable life. Thus plainly showing that the conditions necessary to vegetable existence are absent. Now, in a general way, those conditions may be summed up as air, light, heat, soil, and moisture. One of these we know to be present in the moon, from the fact that it is a solid material body, presenting a surface of mountain and plain, consequently there must be no lack of *soil*. Other two of the necessary conditions it undoubtedly has, in the light and heat it receives so unstintedly from the sun; but those of air and water seem to be entirely awanting. Even the best observers fail to detect the presence of an atmosphere, while all are agreed that if such there be, it must be so extremely rare as to be imperceptible. Having thus no atmosphere, it follows that it must be no less destitute of water. It is a well-known fact that but for the pressure our atmosphere exerts upon the seas and oceans of our globe, their waters would rise to the boiling point and pass away in vapour; and the more so if, as in the moon, the sun shone continuously for two weeks out of the four; the result of this would be that our now fair earth would very soon present an aspect similar to that we now behold in the moon.

The moon only turns upon her axis once in 28 days, hence her day and night are each a fortnight in duration. Now, just imagine a heat far exceeding in intensity that of Central Africa, a heat sufficient to make water boil, glaring upon our fields for fourteen days at a stretch, and that without a cloud or breath of air to modify it; what living thing could stand it? And when we reflect that this state of things is immediately succeeded by the absence of all light and heat for another fourteen days, producing a cold so intense that our lowest polar temperature would be mildness itself compared to it, and you will see why it is that vegetable and animal life—such as *we* know them to be—could not possibly exist on the surface of our satellite. No doubt, the theory has been propounded that possibly that side of the moon which we never see owing to the fact that it is always turned away from us, may be the abode of living things. To this, the reply of the astronomer is, that the moon in the course of her librations does present a small portion of her farther side for our inspection, sometimes at the one side, and sometimes at the other, yet in these the same desolate aspect is no less apparent. In short, it just comes to this, that the moon—with all her soft and silvery light and beauty—is but a rounded mass of slag and ashes, a desert world floating on the blue bosom of space without a rag of atmosphere to cover her nakedness.

So far, then, as we can perceive, the moon seems to have been created for the express purpose of fulfilling the double duty she now discharges to our earth;—first, as a mirror to reflect the light of the sun; and, secondly, as a magnet to attract the fluid portions of our globe, so as to produce what is known as the ebbing and flowing of the tides.

Certain effects have been attributed to the influences of the moon, such as change of weather, and mental derangements; but science declares both to be mere popular fallacies. It is astonishing how many people—not excepting even some of the more intelligent—are to be found who have the most hazy notions of the cause of the changes of the moon. Nor are the illustrations we find in astronomical books of a nature to help them out of their difficulties, but rather produce the opposite effect of making confusion worse confounded. The most simple and effective way to illustrate the phases of the moon, is to hold up a ball betwixt you and the light of a candle or gas-burner, when the side of the ball nearest you will be in shadow; but move it a little toward the left, as if it were going in a circle of which you yourself are the centre, and a thin crescent of light will make its appearance on the right-hand side of the ball. Continue to move it circularly to the left, without shifting your own position, and, by and by, one half of the side of your ball will be illuminated. Still continue the movement, and meanwhile turn your back upon the light, and the whole of that side of your ball nearest you will be illuminated. Still continuing to move your ball in the same curve, a sickle of shadow will make its appearance at the right edge, which will continue to grow as you approach your ball nearer to the light, till you get once more your half orb, then your crescent, and finally darkness as at first; for by this time your ball will again be betwixt you and the light and, as it were, *standing in its own light.* This is the position of the moon when it is said to *change;* being betwixt us and the sun, no light falls on the side that is nearest us, but as it passes round to the south-west, it gradually presents those well known phases from crescent to full moon, by which time it is opposite the sun; after which it gradually declines, till it again comes betwixt us and the sun, when we have what is called dark moon.

The moon does not always keep the same tract in the heavens, but deviates from it more than twenty times her own apparent breadth, so that she is nearer to us at one time than at another by 30,000 miles. At such times her apparent diameter is greater than when she is at the opposite part of her course, hence the harvest moon appears larger than usual. It is also a common belief among country people that what is called the harvest moon rises for nine nights in succession at the same hour. But this is incorrect, as during the period referred to, it rises only twenty minutes earlier than usual; its usual rising time being fifty minutes later each day. The cause of this difference is said to be owing to the fact that that part of its path which extends between the signs of *Aries* and *Pisces*, is less bent than any other portion of it.

An eclipse of the sun is caused by the moon coming directly between it and the earth. If the moon happens to be at her nearest to the earth, the whole of the sun's disc is obscured; but if at the utmost limit of her course a ring of light remains outside of that part of the sun which is under eclipse, this is termed an annular eclipse.

CHAPTER XIII.

The Interior Planets: Mercury, Venus, and Mars—The Exterior Planets: Jupiter, Saturn, Uranus, and Neptune.

THE word planet signifies a wanderer, in allusion to the fact of their shifting their positions among the stars. This phenomenon was noticed in very early times, and being unable to account for it, they termed such stars planets, or wanderers. There are eight principal planets revolving around the sun, namely—Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. The first four, being those nearest the sun, are termed the *interior* planets of the system, and the last four, the *exterior*. Betwixt the two occurs a vast interval which is occupied by what are termed the Asteroids, or minor planets,—sometimes termed Planetoids, which mean the same thing; these now amount to the respectable number of 220. Besides these, there are, at least, twenty satellites apportioned to the principal planets, as follows:—Neptune, 1; Uranus, 4; Saturn, 8; Jupiter, 4; Mars, 2. The latter have only been discovered within the past two or three years, so that the term "Moonless Mars" is no longer applicable to that planet. Earth has one moon; and it is still a debated question whether Venus has also a small satellite. A number of eminent observers witness to having seen it, while some who are equally reliable maintain the opposite opinion. So that of planets and satellites we have 240, constituting the solar family. This is exclusive of comets, many of which, though they occasionally enter our system, are not members of it.

The planets are always to be found on or near to the plane of the ecliptic, or path of the sun. Like him they rise in the east, and set in the west. Mercury is seldom seen with the naked eye, owing to its proximity to the sun; the best time to look for it is about an hour after the sun has set, or about an hour before he rises. Venus, when at her best, is the brightest of all the planets, and never very far from the neighbourhood of the sun. Through a small telescope she may be seen passing through her phases, as in the case of our moon; hence her varying degrees of brightness. When to the right or west of the sun Venus is the morning star, but when seen at night it is always to the left. In the latter case it sets after the sun; in the former, it rises before the sun. Mars is easily recognised by his ruddy colour, and by his being much farther from the sun. Jupiter, though an immense distance from the sun, is almost as bright as Venus, owing to his vast dimensions, he being the largest of all the planets, so large that 1,230 earths could find stowage in his interior—supposing that his orb was hollow instead of solid. Saturn is not so easily recognised with the unaided eye, being both smaller and less bright than Jupiter, but through the telescope he is known at once by his ring. The planets may be also known from the stars, by the fact that they do not twinkle, but emit a steady lustre.

Mercury is the densest as well as the swiftest of all the planets, sweeping round his orbit in the short space of eighty-eight of our days, and at the enormous rate of more than a hundred thousand miles an hour. His diameter is not much more than one-third that of the earth, and being so much less in bulk, his attraction is proportionably less, so that what would be a pound in weight with us, would only weigh seven ounces there; hence, animals of the heaviest calibre, such as our elephant or hippopotamus, would, on the surface of Mercury, be as light and agile as the deer or Arabian steed. Upon the whole, then, even with the telescope, we see nothing in the condition of Mercury to hinder it from being the abode of living creatures akin to those which exist on earth.

The orbit of Mercury is very eccentric, that is, longer than it is broad, so that twice in the year, he is farther from the sun than at other seasons, but when at his nearest distance, the light and heat which he receives from the sun is ten and a-half times more than we receive; while at his greatest distance, he only receives about one-half that amount. But even then, the sun's orb will appear to the Mercurians about four and a-half times larger than he appears to us; while at his nearest point he will be even larger. But the most remarkable feature about Mercury is the shortness of his year, seeing that he accomplishes his journey round the sun in eighty-eight days or less than three months, consequently his seasons are only about three weeks long. This as a matter of course would entail much greater rapidity in the growth and maturity of vegetable organisms than we are familiar with. But this may well be, seeing that the heat it receives from the sun is so much greater, so great indeed that if there be no clouds in the atmosphere to modify it, it will amount to at least four or five times that of boiling water. Supposing, therefore, that his equator was traversed by seas, these would in a very brief period be all boiled away. Again the climatic conditions of a planet very much depend on the amount of inclination of its axis to the plane of its orbit. In the case of Mercury this has not been sufficiently ascertained, owing to its proximity to the sun. So far as can be ascertained the density of its atmosphere is greater than that of the earth, while it appears to be loaded with masses of vapour. But, whatever may be the state of matters in its equatorial regions, there are ample grounds for supposing that its temperate and polar regions are fit to be the abode of living creatures, though in some respects they may be different from those of our own planet.

Venus, the next planet in order of distance from the sun, is 7510 miles in diameter, and in this respect only a little less than our own planet. As seen by us, it is by far the most beautiful orb in the solar system. Her similarity to our own planet in size, situation, density, length of seasons, form of orbit, amount of light and heat, is such that the two planets might almost be termed sisters. In some respects, however, they are very unlike. If it be true, as some astronomers tell us, that her axis is very little bent from the perpendicular, her heat will be so great as to be unbearable to creatures like ourselves. But if, as others suppose, the inclination of her axis be something like our own, there is every reason to suppose that Venus is inhabited by creatures such as those we are familiar with. The amount of heat she receives from the sun is greater than that we receive in the proportion of sixteen to nine, which is nearly double. Possibly the heat in the equatorial regions may be unbearable to beings such as we are acquainted with, but may there not be creatures there adapted to live in such regions? The natives in our own tropical regions live in health and comfort, while Europeans when transported thither do not live many years.

At all events there must be large tracts of country lying in the direction of her polar regions fitted to support both living and rational creatures. It is still a matter of dispute whether the planet of Love is in possession of a moon. Astronomers of no little eminence have declared that they have seen her accompanied by a satellite. Short, the astronomer, saw it with two different telescopes and four different eye-pieces. He saw it no less than four times between May 3rd and 11th, 1761. In March, 1764, it was seen by Rodkier; Horrebow saw it a few days later; and Montbaron saw it in various positions on March 15th, 28th, and 29th. An observer no less skilful than the late Admiral Smyth was disposed to believe in it. Nor need we wonder that such an object has not been seen by other observers equally alert, when we remember that not till last year was it discovered that the planet Mars is accompanied by at least two moons. In the case of Venus there will be less necessity for the services of an attendant orb, seeing that she is much nearer to the sun, and consequently better supplied with light, while the raising of her tides will be much more effectually performed for her by the attraction of the sun.

Venus, as has been already said, is by far the brightest in the firmament, so bright that in certain positions she causes a perceptible shadow. Sometimes, in favourable circumstances, it may be even seen in the full light of day. She is only visible for about 3 or 4 hours before sunrise, or after the sun has set, according as she is a morning or evening star. Owing to the fact that she is nearer to the sun than ourselves, we cannot possibly see her in opposition to the sun, consequently, to us she is never at the *full.* If when at that point of her course which is nearest to the earth, we could see her fully illuminated she would shine with twenty times her ordinary splendour, and appear to us a little moon, seeing that in such a position, she would be one hundred and thirty millions of miles nearer to us than she is at the opposite side of her orbit.

The phenomenon of twilight has been observed on Venus, notwithstanding the fact of her densely clouded atmosphere. She is an object of no little interest and importance to astronomers on account of her transits, on which occasions she passes over the disc of the sun in the form of a small round black spot. It is by means of these transits that astronomers are able to calculate the distance of the sun, as well as that of the other planets. On account of her superior lustre, Venus had greater attractions for the sons of men than any other of the solar family; as an evening star she was known to the Greeks and Romans as *Hesperus*, and as a morning star as *Phosphorus*. In the Apocalypse it is referred to and made to symbolise the Saviour, as the "Bright and Morning Star;" while in another place it is the "Day Star."

If Venus be the twin sister of Earth in respect to size, form of her orbit, etc., Mars bears a yet closer resemblance to our globe in its physical appearance. "It is singular," says R. A. Proctor, in his "Other Worlds than Ours," "that among all the orbs which circle round the sun, one only, and that almost the least of the primary planets, should exhibit *clearly* and *unmistakably* the signs which mark a planet as the abode of life." The ruddy appearance of Mars has been noted from the earliest ages, and in all likelihood it was from this that it received its name. The cause of his redness is attributed by some to his dense and extensive atmosphere, while others consider the cause to be geological, thinking it probable that extensive tracts on his surface may be composed of some rock similar to our red sandstone. Others, again, attribute the phenomenon to his vegetation, which may be red instead of green, owing to his more scanty supply of sunlight. The planet is also remarkable for its changes of aspect, sometimes presenting a large and brilliant orb, at others dwindling to the merest speck. This is owing to striking changes in his range of distance from earth, varying from fifty millions of miles to upwards of 230 millions.

Mars is about 5000 miles in diameter, while his surface is two and a half times less than that of the earth. His density is also much less, so that, as in the case of Mercury, men and animals of the most gigantic proportions could, on his surface, move with far greater freedom and agility than they do on earth. The orbit of Mars is very eccentric—that is, longer than broad; consequently, when farthest away from the sun his light and heat are about one-third less than when at his nearest. This, as will be seen, must in no slight degree affect his climatic condition. At his mean distance from the sun the amount of light and heat he receives is not much more than one-half the amount we receive. His year is nearly twice the length of ours. It consists of 687 days, while his day is longer than ours by about forty minutes. In the physical aspect Mars presents to us, we have quite a miniature of our own planet. In no other planet do we behold such features so clearly defined. Viewed through the telescope these features appear to us as seas and continents, seemingly far more equally distributed over its surface than are those of Earth. Viewed with the naked eye, the most striking feature is its ruddy colour, but through the telescope this ruddy hue is confined to the parts supposed to be continents, while the intermediary portions, being of a darker and rather of a greenish tint, are supposed to be seas. These seas and continents have not only been mapped out by astronomers, but have been all named—as, for example, there is Herschel's Continent, Dawe's Ocean, Naysmith's Inlet, Philip's Island, Arago's Strait, Sechi's Continent, Keplar Land, Maraldi Sea, Huygens' Inlet, etc. Another very striking and no less significant feature is that on each of his poles there is a bright spot which clearly indicates the presence of snow or ice in great quantity. Mars, like Earth, is partially obscured with what seem to be clouds; indeed, they must be, seeing that the spectroscope indicates the presence of watery vapour. These are seen to shift and change their form, but the green and ruddy tinted spots are always permanent, so that there is very little doubt but that Mars possesses the conditions necessary to the support of life—animal, vegetable, and even intellectual.

The vast interval which separates the inner from the outer planets—or between Mars and Jupiter—amounting to 340 millions of miles, was somewhat puzzling to astronomers, considering the regularity of distance separating the other planets, so that they began to question whether one or more planets, hitherto unobserved, might not be quietly pursuing their way in this great wilderness of space altogether unknown to the terrestrials. By and by the idea was found to be correct by the discovery of two small planets in the year 1801, and that on New Year's Day, being also the first day of the 19th century. The discoverer was Piazza, an Italian, who found it wandering among the stars of *Taurus*, and the new planet was named Ceres. This discovery set others on the alert, and the result was the finding of Pallas, on the following year. This was followed by that of Juno in 1804, and Vesta in 1807. No addition was made to these discoveries for 38 years. In 1845 the spirit of discovery once more awoke, and was rewarded by the finding of one after another of small planets, till now they amount to 220. Some of these planets are so small as not to exceed in size an English county. At first the hypothesis was started that the planetoids had originated in the disruption of some large planet like Jupiter, but now astronomers have abandoned that theory, and hold that they have been formed in the ordinary way, but owing to some interrupting force prevented from taking the form of a great planet. But be this as it may, if the nebular theory be at all correct, such bodies, owing to their inferior dimensions, must have cooled so rapidly as to have long since become unfit for the support of either animal or vegetable life.

Away out beyond the zone of the Asteroids we come upon the magnificent planet Jupiter, which has been well named the prince of the solar system. And if mere size were the measure of a planet's fitness to be the abode of life, Jupiter might well be looked upon as the dwelling-place of the very nobility of creation. In volume it is one thousand two hundred and thirty times that of the earth, and more than three hundred times greater in mass. Jupiter has four attendant moons, the beauty and perfections of whose motions are marvellous to contemplate. The planet's rate of motion must, considering his immense bulk, be fearful to behold; and, rotating on his axis in less than ten hours, his day is less than ours by at least one-half. His axis has been found to be perpendicular to the plane of his orbit, so that there can be no appreciable change of season on his surface, but rather perpetual spring. Gravity at his surface is about two and a half times that of earth, so that a pound with us would weigh two and a half pounds on Jupiter. Consequently a man weighing, say, ten stones, would on Jupiter weigh twenty-five. And as we can well conceive the difficulty of bearing such a burden, we are led to believe that, if there are living creatures on his surface, they must be differently constituted from those with which we are acquainted. But the most remarkable feature connected with the planet, as seen through the telescope, is the fact of his being traversed by enormous cloud-belts, and that more particularly in the regions of his equator. If he were in a position to receive as much heat from the sun as we do, we would be justified in attributing such masses of vapour to the action of the sun, which, by the process of evaporation, so loads our own atmosphere; but when we reflect that his distance from the sun is such that the amount of heat he receives is not more than one twenty-fifth of that we receive, we are led to attribute the cause of the phenomena to gigantic forces at work upon his surface. That such forces are there in active operation is evident from the rapid changes that are seen to take place in these belts. Nor can such changes be ascribed to storms caused by alternation of seasons, seeing that owing to the perpendicular position of his axis no such changes are possible. Yet, however caused, storms are supposed to be raging on his surface of a character so terrific that life there would be a matter of impossibility. On the other hand, astronomers are now of opinion that this gigantic planet partakes more of the nature of his parent, the sun—that, like it, he is enveloped in masses of thick vapour generated by his intense heat; that, in short, Jupiter is still in a state of semi-incandescence, and consequently still but in the infancy of his development as a planet. And if, as Bischoff calculates, the earth has taken three hundred million years to reach its present degree of temperature and development, Jupiter, owing to its greater bulk, would require that period lengthened by at least one thousand times ere he reached the same point of development. This view of his condition is also supported by the fact that his mean density is only about one-fourth that of the earth, which is accounted for by his possessing such an exceedingly high temperature. Moreover, as in the case of the sun, immense spots or openings, many thousand miles in diameter, have been observed in his cloudy envelope, still farther favouring the opinion that mighty forces are at work on his surface.

But though this magnificent planet may not for millions of centuries be in a condition to permit of the existence of animal, vegetable, or intellectual life, may it not be that like the sun himself he is the dispenser of life-force—in the form of heat, at least—to the four moons that attend upon him? When it was first discovered that Jupiter was attended by a retinue of no less than four satellites, it was supposed they were there for the express purpose of making up, by their united luminosity, for the deficiency of light supplied to him by the sun; but the fallacy of this view was seen at once when confronted with the fact that, owing to their great distance from the sun, their combined light would not be more than one-twentieth of that we received from our moon. And as, moreover, at no time can all four be full at once, the amount of light supplied to the planet from this source must be exceedingly small. The moons of Jupiter being in size at least equal to the four primary planets—Mercury, Venus, Earth, and Mars—and supposing them to have begun their career simultaneously with our own planet, it follows that they will have reached a similar degree of temperature, and consequently be in a condition to support life. No doubt the present condition of our own satellite tells against the theory, but we must remember that our own moon being a much smaller body than the earth, or the moons of Jupiter, would cool much more rapidly, and so reach the point of inhabitability much sooner than they; and now it is supposed shè has reached a degree of temperature so low as to render her unfit for the support of life, while for the same reason her axillary rotation has declined to one revolution in twenty-eight days. Who knows but there was a time when, like her mother orb, our satellite swarmed with life, including beings kindred to ourselves; but of this the most powerful telescopes reveal not the slightest indications. Were there on its surface the ruins of buildings like the Great Pyramid, or even like St. Paul's Cathedral, the far-piercing eyes of such instruments would detect them; but instead of this we only behold scenes of physical desolation and death. True, there are to be seen mountains of immense height, valleys and crevices of frightful depth, vast plains resembling old sea bottoms, but nothing in the shape of lake, or sea, or fountain, not even a cloud, or an atmosphere in which it could float. No wonder, then, that our astronomers have come to look on our fair satellite as a huge cinder afloat in space, its hemispheres alternately roasting in the fiery glare of a cloudless sun, or exposed to the most extreme degree of cold; so that our own moon, owing to its inferior magnitude, does not justify us in following the law of analogy with reference to the moons of Jupiter, though we might with safety follow it in forming an idea of the condition of the Asteroids.

As a matter of course, the farther a planet is from the sun, the larger will be its orbit, and the longer will be its year; hence, that of Saturn—the next planet in order of distance—is about thirty of our years, while that of Jupiter is about twelve. We learn from Sir John Herschel that the rings of this planet cause an eclipse—first of its northern, then of its southern hemisphere—for a period of nearly fifteen years. But according to more recent investigations total eclipse from this cause does not continue for more than seven years, even to his polar regions. But even this would be unendurable to an inhabitant of earth. At one time it was popularly supposed and taught that the rings of Saturn were provided by the Creator in order to compensate for the deficiency of solar light, which was thus made up by the extraordinary amount reflected from the surface of the rings. But such enthusiasts quite overlooked the fact that by the interposition of said rings more of the sun's light is intercepted than they can possibly supply by reflection. No doubt the planet is attended by no less than eight moons, but their extreme distance from the sun will—as in the case of those of Jupiter—permit them to reflect but a meagre supply of light to the planet, an amount not exceeding one-sixteenth of that we receive from our moon. Saturn, like Jupiter, is swaddled with belts of vapour, varying in colour from a dark grey at the poles to a brilliant white at his equator. From the shifting and changing of these belts astronomers are of opinion that, as in the case of Jupiter, mighty internal forces are at work producing great changes on his surface—in short, that he is not yet in a habitable condition, but more likely to be a heat—if not a light—dispensing sun to his attendant moons. In support of this view we have, besides his low density, which is less than that of water, the fact, observed by Sir William Herschel and others, that he is subject to changes of outline, appearing sometimes as if flattened in one part and raised out of all proportion in others, thus plainly indicating that he is not in a solid state. This phenomenon was first observed by the elder Herschel, on which occasion it took the form of an oblong with rounded corners. The same phenomenon has also been witnessed by other trustworthy observers, so that among astronomers it is now familiarly spoken of as the planet's "square shouldered aspect." From these considerations, then, we may almost take it for granted that Saturn, like Jupiter, is not the abode of creatures such as we are familiar with on earth, but that he is still, and may be for millions of centuries to come, subject to the action of those forces which have to do chiefly with the development of the mineral kingdom, by which process planets ultimately become fitted to support the three higher kingdoms of Nature—namely, the vegetable, the animal, and the intellectual. At the same time, as we have already said, it is not unlikely that the forces emanating from him may be utilised for the support of living creatures in the eight lesser worlds that constitute his family circle.

Having thus found that the two most gigantic orbs in our system are not apparently in a state fit for habitation, it is still less to be expected that the two immeasurably more distant planets, Uranus and Neptune, should be in an exceptional condition. These, the two exterior orbs of our system, have been well named the Arctic planets; and the more so when we reflect that the distance separating Saturn from Uranus is at least ten times that of the earth from the sun, while the orbit of Neptune extends as far beyond Uranus as does that of the latter beyond Saturn; so that, altogether, an interval of 900 million miles intervenes betwixt Uranus and Saturn on the one hand, and a distance equal in amount betwixt Uranus and Neptune on the other. They are both inferior in point of size to Jupiter and Saturn, yet each of them outweighs the whole mass of the four inferior planets, of which our own is the chief. Situated at such an immense distance from their parent orb, these planets can receive but a very meagre supply of solar light and heat; so great, indeed, that to the eye of a man looking from the surface of Neptune, the sun would present no appreciable disc, but simply appear as a point of light shining with a brightness not much superior to that of *Sirius*. And if farther proof were needed in support of the theory that the outer planets of our system are only in the infancy of their development, have we not the indisputable fact that the rings of Saturn—once supposed to be solid reflecting bodies—are meteoric zones, which in process of time will either become one with the planet or add to the number of its moons? in short, that they consist of fragments of rock or meteoric dust, held in position by the attraction of the planet. And as the rings are known to be contracting, they are in all likelihood continually raining down showers of stones and ashes upon the body of the planet. Indeed, this process seems to be going on, more or less, in all the members of the solar system, our own earth not excepted. It is computed that hundreds of thousands of these bodies become incorporated with the earth every twenty-four hours, and 400,000,000 each year. They vary in weight from a few grains to a ton; one is known to have fallen in South America which weighed fifteen tons. Yet these small accretions of matter would take many millions of years to add a single foot to the earth's thickness.

CHAPTER XIV.

What then are the Stars?—For what purpose do they shine?—Analogy the Key to the whole—Beauty and Harmony of the Universe—Old age and decay of our World—Probable return of the Earth and other Planets to the Sun—Is there a Spirit-World?—If so, where is it?

HAVING thus traversed the area of the solar system from the planet Mercury in its innermost court to Neptune on its farthest verge—and having obtained, so far as observation and analogy will permit, something like a knowledge of the present character and condition of the various orbs it contains, we are now in a position in which we may with some degree of confidence carry our researches to the more remote systems of the stellar universe. In the first place, then, we think we are justified in concluding that the distant stars are immense globes, similar to our own sun in character and constitution, seeing that they radiate light sufficient to render themselves visible to us at a distance of at least sixty billions of miles, while others must be more than twice that distance. Nor could such bodies send their light through such vast intervals, unless, like our own sun, they exist in a state of intense heat, or incandescence. From this it follows that they must send out immense volumes of heat energy; and, knowing as we do the value of such energy in producing and carrying on the physical and vital phenomena of planetary existence, we think we are justified in concluding that those stellar forces are not wasted in their radiation into space, but utilised by systems of planetary worlds which must ever remain invisible to us, seeing that as planets they can only shine by reflected light, which is too weak to render them visible to us at such inconceivable distances. But the question may be asked—May they not be simply great lights without possessing the material constitution and characteristics of our own sun, since—even to our most powerful instruments—they present no appreciable disc, but appear simply as mere points of light? The answer to this is, that we have evidence leading us to the conclusion that the stars possess both mass and density, seeing that, as in the case of double stars, they act and react upon each other by the law of attraction. But even this argument for a long time failed to convince those who were opposed to the theory of a plurality of worlds, till corroborated in more recent times by the marvellous revelations of the spectroscope. Chief among these was the fact that the light of those distant orbs passes—in the case of each of them—through a gaseous envelope containing elements identical with or similar in character to some of the elements found in the photosphere of our own sun, and which we find in more solid form in the strata of our own planet. Such elements have been found present in the luminous envelopes of a number of the brighter stars, as in *Aldebarran*, the principal star in that division of *Taurus* known as the *Hyades*. By the indefatigable researches of Professors Muller and Huygens, it has been found that the vaporous envelope of this star contains sodium, magnesium, calcium, hydrogen, iron, bismuth, telurium, antimony, and mercury. In *Betelgeux*, the bright, red star in *Orion's* right shoulder, they found distinct indications of the presence of sodium, magnesium, calcium, iron, and bismuth; while in a number of stars examined with equal care they found, besides these, indications of other substances quite unknown to us terrestrials. Now, facts such as these, it must be admitted, carry us a long way towards forming a rational and satisfactory conception of the nature and present condition of the stellar worlds. Now we know that the iron that turns the soil, in the shape of spade or plough, that conveys myriads of men and mountains of merchandise from one continent to another in our steam-ships and railway trains, that spans our rivers in bridges and viaducts, that covers the earth with a network of railways, and that is turned to myriad other no less useful purposes, once lay—and that not so long ago—unused in the bowels of the earth; we know, moreover, that there was also a time, away back in the distant past of our planet's history, when those marvellous productions of modern times existed in the form of incandescent vapour in the then nebulous mass of the sun; and when we find in the countless suns that light up the areas of distant space those same materials, though in a state of vapour, are we not justified in concluding that the planetary worlds, swayed by those distant suns, are built up of the same or similar materials? And, granting this, is it one whit less reasonable to think that such materials are being utilised, or will be, when such planets are sufficiently developed as to be the happy abodes of beings similar to ourselves? But, as in the case of our own system, it does not follow that because in the luminous envelopes of the stars the spectroscope reveals elements identical with, or similar to those of which our own planet is built up, that all the planets belonging to the various solar systems in the universe are in a habitable condition. In all likelihood a vast number may still be in the infancy of their development, while others, like our own moon, may have long ceased to be the abodes of living creatures. Nay, it is now supposed that a number of the stars have lost so much of their energy through constant and long-continued radiation, that they are approaching a point at which they will be no longer able to supply life-force to their respective planets. It would thus seem that—as in man, the lower animals, and plants—so also in the stellar and planetary worlds, inhabitability, life, growth, greatly depends upon temperature; where there is heat there is life, or the possibilities of life; and where there is cold there is death, or the absence of life. Suns and systems, planets and satellites, bud, blossom and die; and just as the withered leaf drops from the tree and returns to the bosom of mother earth from which it sprung, even so will earth itself with her sister planets, when no longer habitable, be gathered again to the bosom of the sun, and in all likelihood with such force as to convert the whole mass once more into nebulous vapour, to be again in the process of ages formed into planetary worlds, but on a grander and more perfect scale.

What may be the time allotted to the life of a planet will, as we have already shown, altogether depend on its size; and if our world has taken 500 million years to reach its present stage of development, is it too much to suppose that other 500 million years may elapse ere it reach the end of its pilgrimage? From geology we learn that as the earth grows older, it also grows colder, and that on this account the waters will gradually diminish; and for the same reason, the atmosphere will gradually become so attenuated as to be too thin to breathe; then great cavities will form all over the surface of the earth, into which the waters will be absorbed and disappear, and at last in the final stages of our planet's death, the atmosphere will also disappear. Then earth and her satellite, all desolate and naked, will hand in hand together return to the glowing bosom of their great parent the sun. Those stars which through the telescope, and even to the naked eye, appear of a ruddy tint are supposed to be in this condition. And as we have seen that one star differs from another not only in glory, but in their material constituents, even so must the products of the various planetary systems, and one planet from another. Here, then, we are brought face to face with perhaps the greatest marvel in the universe of God, and that is its infinite variety. It is this that causes that ever new and never-ending delight in those who study the phenomena and laws of the universe, and more particularly in those who see in such phenomena the unmistakable evidence that the Creator is a being who takes supreme delight in ministering to the happiness of all His creatures. What a vast and wonderful field have we thus opened up to us! What an overwhelming subject of thought and contemplation! Not a star that twinkles in the silent midnight sky but is the parent-sun of a system of worlds like unto our own; worlds which may be the abodes of myriads of intelligences, each distinguished by its characteristic races and productions, yet possessing points of resemblance and relationship sufficient to show that they each and all form parts of one magnificent and perfect whole.

In all this we have said nothing of that infinitely grander spiritual universe, a belief in which we, as spiritual and immortal beings, are bound to cherish. Not that we doubt or deny its existence, but simply that we prefer to leave it to the imagination and faith of our readers. We ourselves firmly believe in its existence—not as being located far away beyond the boundaries of the material universe, but with the good Isaac Taylor, that it interpenetrates that universe, or possibly that it surrounds each inhabited globe, just as our own earth is encompassed by the celestial vault in which it moves, or by the atmosphere in which its living myriads breathe. To quote Taylor's own words—"Is this constant principle of the visible world, which shows itself in a thousand ways around us—is it exhausted and done with in the instances which our modern physical discoveries have brought to light? We should confidently assume the contrary, and believe nothing less than that it has a still further and higher play in relation to the sentient and intellectual universe—that is to say, we insist upon the abstract probability of the existence, on all sides of us, of an invisible element, sustaining its own species of beings; some, perhaps, as slenderly endowed with rational faculties as are the insect tribes of earth, and others in gradation, rising to the highest pitch of intelligence and moral dignity—some accountable and immortal, others ephemeral, and prompted only by instincts. Our present conjecture reaches to the extent of supposing that, within the space encircled by the sidereal revolutions, there exists and moves a second universe, not less real than the one we are at present conversant with—a universe elaborate in structure, and replete with life; life agitated by momentous interests and perhaps by frivolous interests—a universe conscious, perhaps, of the material spheres, or unconscious of them, and firmly believing (as we do) *itself* to be the only reality. Our planets in their sweep do not perforate the structures of this invisible creation; our suns do not scorch its plains, for the two collocated systems are not connected by any active affinities." —(*Physical Theory of Another Life*, p. 222.) Such a belief greatly enhances our conceptions of the material universe, and sustains the mind under its fatiguing efforts to grasp its astounding phenomena.

"The golden gates of virtue still unbar
Man's infinite abode,
Man's true and living home,
The Life containing all.
There is no need of Death
To ope the inner world.
The Spirit-form unfolds
Unnumbered faculties—
The swan's unflagging wing—
To bear it far away.
The Dream Life folded lies
Upon the confines dim
Of that mysterious realm
Beyond the Earth and grave.
All who have ever lived,
All who have ever loved,
All who have ever thought,
All who have ever grown
Out of material dust,
Have found the Sphere that folds
The Earth within itself
Where Spirits never die. . . .
Egypt and India live,
Greece with her classic shrines,
All nations of the Past.
Their bright domains are spread
O'er spheres that seem to be
More real than the Earth. . . .
Enlarged by culture, they
Whose sympathies have won
Communion with the race
Of man in myriad worlds,
See with no narrow view,
Think with no narrow thought,
Live with no selfish aim,
But in their thought embrace
The universal all. . . . .
This is the Golden World
Of Nature's blushing prime,
Where bloom the golden flowers,
Where dwell the golden days,
Of golden-thoughted love.
How wondrous are Thy works,
Spirit of Beauty! . . . .
There are no solitudes,
No burnt, extinguished suns,
No blood-red bleeding spheres,
No blasted, blighted earths,
No cleft and jagged moons
Within the vast domain
Where Thou art all in all."

—*Golden Age.*

THE SOUTHERN CONSTELLATIONS.

To the inhabitants of the other side of the globe—including Australia and New Zealand—the constellations seen in their skies do not present that picturesqueness of outline which is so characteristic of the star groups of the north. Nor have they a central star, such as our *Polaris*, to indicate the Polar axis and serve as a point of rest for the ever shifting constellations. No slowly wheeling "Arthur's Wain" to work off by its position the hours of night, or seasons of the year. Perhaps the constellation approaching nearest to our Plough in this respect is that of the Southern Cross, *Crux Australis.* In its immediate neighbourhood we have *Centaurus*, the Centaur, with its splendid first magnitude star *Alpha*, which astronomers have now ascertained to be the nearest star to our system, being only about 38,462,060,000,000 miles. To the right of the Centaur is *Argo*, the Ship, which, as we have elsewhere said, is partly visible to us. The southern celestial sphere, however, is said to be richer in coloured stars than the northern; and no less rich in nebulæ, as for example, the Magellanic Clouds, which are two great cloudy masses of light, something of the nature of the Milky Way, but in no way connected with it.

The names of the Constellations of the southern celestial sphere are as follows:—

*(Those marked thus * are invisible in our latitude.)*

	No. of Stars
Argo, the Ship	64
* Ara, the Altar	9
Canis Major, the Great Dog	31
Canis Minor, the Little Dog	14
Corvus, the Crow	9
Crater, the Cup	31
Columba, the Dove	10
* Crux Australis, the Southern Cross ...	6
Cetus, the Whale	97
* Centaurus, the Centaur	32
Corona Australis, the Southern Crown ...	12
Eridanus, the River	84
Hydra, the Snake	60

	No. of Stars.
Lepus, the Hare	19
Lupus, the Wolf	24
Pisces Australis	24
Orion	78
(The above are the older Southern Constellations as known to the ancients; those which follow have been arranged and named by astronomers of modern times.)	
* Robur Caroli	12
* Grus, the Crane	13
* Phœnix...	18
* Indus, the Indian	12
* Pavo, the Peacock	14
* Apus, the Bird of Paradise, ...	4
* Apis Musca Australis	4
* Triangulum Australis, Southern Triangle	5
* Pisces Volans, Flying Fish	8
* Camelion (nearest to the Pole) ...	10
* Dorado, the Sword Fish	6
* Toncan, the American Goose ...	9
* Hydra, the Water Snake	10
Sextans, the Sextant (under Leo) ...	41
Monoceros, the Unicorn	31
The Sculptor's Apparatus	12
* Circinus, the Compasses	7
Brandenborgium Sceptrum	6
Equleus Pictorius	8
Fornax Chemica	14
* Horoglium, the Clock...	12
* Mons Mensa, the Table Mountain ...	30
Machina Pneumatica, the Air Pump ...	24
Norma, or Euclid's Square	12
* Octans Hadleianus, Hadley's Octant	43
Pyxis Nautica, the Mariner's Compass...	8
* Reticula Rhomboidalis	10
* Telescopium, the Telescope	9
* Sculptoria, the Engraver's Tools ...	16
Microscopium, the Microscope	10
Total number of stars, ...	1027

NORTHERN CONSTELLATIONS.

*(Those marked * never set in our latitude.)*

	No. of Stars.
* Ursa Minor, the Little Bear	24
* Ursa Major, the Great Bear	87
* Draco, the Dragon	80
* Cepheus	35
Boötes, the Herdsman	54
Corona Borealis, Northern Crown	21
Hercules, with Cerberus	113
* Lyra, the Harp	21
Cygnus, the Swan	81
* Cassiopeia, the Lady in her Chair	55
Perseus, the Deliverer	59
* Auriga, the Waggoner	66
Serpentarius, the Serpent Bearer	74
Serpens, the Serpent	64
Saggita, the Arrow	18
Aquila, the Eagle	71
Dolphinus, the Dolphin	18
Equleus, the Horse's Head	10
Pegasus, the Flying Horse	89
Andromeda	66
Triangulum, the Triangle	10
* Cameleopardalis, Cameleopard	58
Leo Minor, the Little Lion	53
Coma Bernices, Bernice's Hair	43
Vulpecula et Anser, Fox and Goose,	35
Lacerto, the Lizard	16
Scutum Sobieski, Shield of Sobieski	8
Canes Venatici, the Grey Hounds	25
* Lynx,	44
Cerberus	4
Mons Menelaus	11
Taurus Poniatouski	7
Musca, the Fly	6
Tarandus, the Reindeer	12
Total number of stars,	1444

CONSTELLATIONS OF THE ZODIAC.

	No. of Stars.
Aries, the Ram	66
Taurus, the Bull	141
Gemini, the Twins	85
Cancer, the Crab	83
Leo, the Lion	96
Virgo, the Virgin	110
Libra, the Balance	51
Scorpio, the Scorpion	44
Sagittarius, the Archer	60
Capricornus, the Goat	51
Aquarius, the Water Bearer	108
Pisces, the Fishes	113
Total number of stars,	1016

Total number of stars in all the Constellations,......3487.

STARS OF FIRST MAGNITUDE.

Achernar in Eridanus.
Arcturus in Boötes.
Altair in Aquila.
Antares in Scorpio.
Aldebarran in Taurus.
Alpha in Southern Cross.
Alpha in Centaur.
Betelgeux in Orion.
Beta in Centaur.
Beta in Southern Cross.
Capella in Auriga.
Canopus in Argo.
Castor in Gemini.
Cor Hydrae in the Sea Serpent.
Fomalhaut in Southern Fish.
Pollux in Gemini.
Regulus in Leo.
Rigel in Orion.
Spica in Virgo.
Sirius in Canis Major.
Procyon in Canis Minor.

DISTANCES OF THE NEAREST STARS,

And Time in which Light would take to reach us from them travelling at the rate of 185,000 miles in a second.

Name.	Distance.			Time.
Alpha Centauri, ...	211,330	times the	earth's orbit,*	3½ years.
Alpha Cygnus,......	550,920	,,	,, ...	9½ ,,
Vega,..........	1,330,700	,,	,, ...	21 ,,
Sirius,................	1,375,000	,,	,, ...	22 ,,
Alp. Ursa Majoris,	1,550,800	,,	,, ...	25 ,,
Arcturus,............	1,622,800	,,	,, ...	26 ,,
Polaris, ...	3,078,600	,,	,, ...	50 ,,
Capella, ...	4,484,000	,,	,, ...	72 ,,

THE LARGER PLANETS.

Name.	Distance from Sun. Miles.	Diameter. Miles.	Rotation.			Revolution.		
			H.	M.	S.	D.	H.	M.
Mercury ...	35,393,000	2,962	24	5	28	87	23	15
Venus......	66,131,000	7,500	23	16	19	224	16	48
Earth	91,430,000	7,901	23	56	4	365	6	9
Mars	139,312,000	4,900	24	37	23	686	23	31
Jupiter......	475,693,000	85,390	9	55	28	4,332	14	2
Saturn......	872,135,000	71,904	10	29	17	10,759	5	16
Uranus...	1,753,857,000	33,024				30,686	17	21
Neptune	2,746,271,000	36,620				60,118	0	0

The sun itself is 853,380 miles in diameter, and 1,200,000 times larger than the earth, while his period of rotation is from 25 to 28 days.

The moon is 2,153 miles in diameter, and 49 times less than the earth. She rotates upon her axes once in 27 days 7 hours and 43 minutes, while her average distance from the earth is only 238,793 miles. Her revolution in her orbit occupies the same time as her rotation, namely, 27 days 7 hours and 43 minutes.

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* The diameter of the earth's orbit is more than 180 millions of miles.

COMETS.

OUR little work on astronomy would by many, we have no doubt, be considered incomplete without a few words on those mysterious visitors to our sky, the comets. The name comet is from *coma*, hair, in reference to the hair-like appendage that surrounds the head, and sometimes called the beard. Comets differ from planets in many ways, as, for example, they are not solid bodies, but gaseous in their constitution, consequently they are not all of one shape, but vary in their forms. Some have round misty heads with a bright spot in the centre, which is called the nucleus. Besides the coma or beard they are furnished with long streaming tails that extend over many thousands of miles of space. Others, again, are altogether destitute of those appendages, and simply appear as a more or less hazy star. The planets are cool or cooling bodies, and being opaque reflect the light of the sun, and move on the same plane or level, while comets are diffused, or gaseous bodies at a white heat, and on this account shine by their *own* light, like the sun and stars. Unlike the planets, comets do not move on the plane of the ecliptic, but cut it in all directions, and hence the supposed danger of their coming in contact with the earth.

Some of them move in immensely elongated paths, one end of which enloops our sun while the other may be billions of miles beyond the planet Neptune. Others, again, are supposed to be visitors from other systems, and having a roving commission, move in very eccentric paths, or in open curves that cannot possibly return upon themselves. A number of comets belonging to our system are regular in their periods of return, and have received the names of the eminent astronomers who, by severe calculations, were able to predict the times of their return; hence we have Encke's, Halley's, Biela's, Donnati's, etc. Some comets move in the same direction as the planets, viz., from west to east, while others move in the opposite, viz., from east to west. The brightest portion of a comet is the head, and more particularly, the eye or nucleus. The tail or brush is not always straight, but sometimes curved like a scimitar, and on this account were looked upon by the ancients as portending war.

The period of revolution assigned to Biela's comet is 6½ years, Encke's 3¼, Halley's 76¾ years. The latter will not make its appearance again till the year 1910. These are what are termed *short* period comets; on the other hand, some of the long period comets require from 2000 to 100,000 years to accomplish their journey. Some of these approach much nearer to the sun than those of the short-period family, so close as almost to graze his surface. Sir Isaac Newton calculated that the comet which appeared in the year 1680 approached so near to the sun that its temperature was raised to 200,000 times that of red hot iron, being at its nearest point only about one sixth of the sun's diameter from his surface.

In approaching the sun comets begin to manifest great commotion in their substance. This appears to be caused by two opposing forces—the one causing the comet to throw out jets of luminous matter from its head; the other, which is from the sun, driving them back so as to form the tail, just as the smoke of a railway engine is blown back by the wind so as to form a long white pennon in the wake of the train. No matter in what position the comet may be in relation to the sun, the tail is always turned away from him, so that on retiring from him the tail is made to precede rather than follow the head, or, as we might say, *tail foremost*.

The passage of a comet round the sun is termed its perihelion passage—from *peri*, near, and *helios*, the sun. As an instance of the enormous force exerted by the sun during such passage, the comet of 1680 was made to travel at the rate of 1,200,000 miles an hour, while it threw out a tail 20,000,000,000 leagues in length.* Another, which appeared in 1843, had a tail 112,000,000 miles in length, while the diameter of the head was 112,000 miles, and that of the nucleus 400 miles. The only comet we ourselves have had the pleasure of seeing was that of Donnati, which appeared in the year 1858. It was a very striking object in the evening sky, and drew universal attention. Comets are comparatively rare, not because their numbers are few—seeing that there are millions of them belonging to our system, as well as passing to other systems—but because those only are visible that are suitably placed for observation while passing us on their way to the sun; besides, a vast proportion of them are too small to be seen with the unaided eye, while others again do not approach nearer in their perihelion passage than the orbit of Neptune.

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* Lockyer.

To the people of long ago comets were objects of terror and alarm, being looked upon as portentous warnings of dire calamity to the nations which beheld them. Nor, up till very recent times, were they one whit less to modern spectators, the dreaded danger being their coming in contact with the earth at some unlucky point of its orbit. But even this fear has been in a great measure dispelled by the light of modern science, for it is now found that the matter of which such bodies are composed is of such exceeding tenuity that if condensed into a solid piece some of them would not weigh more than a few pounds, while, as in the case of Donnati's comet in 1858, the stars shine brilliantly through their tails. The fact is that the earth has come into contact with such bodies more than once. As an instance of this, Biela's comet was due at the sun at the end of January, 1866, and ought to have crossed the path of the earth on the 30th of November, but nothing was seen of it till November, 1872, when the earth suddenly broke through it in the form of a mass of meteors.* We well remember the night in question, for we were at the time travelling betwixt Renfrew and Glasgow, and stood still again and again to admire the showers of fiery sparks. But we little dreamt that we were passing through the body of a comet. From this and other modern researches it would seem as if comets and meteors were only different phases of development of the same masses of matter, the latter, perhaps, approaching nearer to the planetary stage. Upon the whole, then, in so far as interrupting the earth in its course or endangering the safety of its inhabitants, we have really very little to fear.

METEORS, SHOOTING STARS, AERIOLITES, &c.

Having thus had a hint as to the identity of origin betwixt comets and meteors, we will now be in a position to understand something of the nature and appearance of the latter. Such bodies are known by the names of meteors, shooting or falling stars, aeriolites, bolides, etc., according to their size and brilliancy. They differ from comets, seemingly, in that they are more solid, and burst into flame when they come into contact with our atmosphere; the larger ones, called aeriolites, exploding with the heat generated in them by atmospheric friction, and generally accompanied by a loud report. Some of those which have been afterwards found are of considerable weight, ranging from a few pounds to many hundredweights. By the common people they were called moon-stones and sun-stones, according as they fell by night or by day. In olden times they were held sacred and carefully preserved in temples and shrines as objects of worship. Of such is the Kabba of Mecca, the palladium of Troy, the sacred shield of Numa, and that of the temple of Diana at Ephesus, supposed to be the image of the goddess which fell down from Jupiter (Acts xix. 35). Of the same class is supposed to be the famous coronation-stone upon which the kings of Scotland were wont to be crowned, and which was taken from Scone along with the coronation-chair to Westminster.

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* Lockyer.

When subjected to chemical analysis these stones are found to consist of metals, chiefly iron mixed with nickel, while others contain traces of cobalt, manganese, chromium, copper and other metals, with a small percentage of oxygen, sulphur and chlorine. The stony matter consists chiefly of silica and metallic oxides.*

But the most numerous class of meteors consist of phosphoric lines and points, and occur, as we have already seen, in showers. The most abundant displays of these are found to take place in the months of August and November, particularly the latter; hence they have come to be known as the November showers. The following extract from the work above quoted informs us how the above term originated, while it gives a graphic description of a fall of meteors that took place on the 13th November, 1833.

"Passing by several meteoric showers, more or less remarkable, we come to the most stupendous hitherto witnessed, that of 13th November, 1833, which being the third in successive years, all occurring in the same month, and on the same day of the month, seemed to indicate periodicity, and originated the name of the November Meteors. The night of the 12th was singularly fine, not a cloud obscured the sky. Towards midnight the spectacle commenced, and was at its height between four and six o'clock in the morning. It was seen all over the United States, from the Canadian Lakes to the West Indies, and from about longitude 61° in the Atlantic Ocean, to that of 100° in the centre of Mexico. It included the three classes of forms previously mentioned—phosphoric lines, large fire-balls, and luminous bodies of irregular shape. One of the latter, observed in the State of Ohio, resembled a brilliant pruning-hook, apparently about twenty feet long by eighteen inches broad. It was distinctly visible in the north-east more than an hour, and gradually declined towards the horizon till it disappeared. Another of tabular shape, appeared near the zenith, over the Falls of Niagara, and remained stationary for a considerable time, emitting large streams of light. The roar of the cataract, the wild dash and incessant plunging of the waters below, with the fiery storm overhead, combined to form a scene of unequalled sublimity. Some persons died of fright. Many thought that the last great day had come.

---

* "The Heavens and the Earth," by Thomas Milner, M.A., F.R.G.S.

"In the Slave States the terror of the negroes was extreme. 'I was suddenly awakened,' says a planter in South Carolina, 'by the most distressing cries that ever fell on my ears. Shrieks of terror and cries for mercy I could hear from the most of the negroes of three plantations, amounting to from six to eight hundred. While earnestly listening for the cause, I heard a faint voice near the door calling my name. I arose, and taking my sword, stood at the door. At this moment I heard the same voice still beseeching me to rise, and saying, Oh, master, the world is on fire! I then opened the door, and it is difficult to say which excited me most, the awfulness of the scene, or the distressing shrieks of the negroes. Upwards of one hundred lay prostrate on the ground, some speechless, and some with the bitterest cries, but most with their hands raised imploring God to save the world and them. The scene was truly awful; for never did rain fall much thicker than the meteors fell towards the earth. East, west, north, and south, it was the same.'" The same author informs us that on this occasion the meteors moved in lines which converged in one point in the heavens, and that the position of this radiant point was in the constellation *Leo;* that they did not fall by the force of gravity alone, the velocity being so much greater than could possibly result from the law of gravitation; that they consisted of combustible matter, for they took fire and were consumed while traversing our atmosphere; also, that several fire-balls were observed, some of them apparently as large as the full moon, and which exploded without making the slightest noise.

It has been ascertained that these bodies are not promiscuously scattered through the space occupied by the solar system, but that they are collected into groups, which move in an orbit as do the comets,—or, might we say? as when they were comets. Now, it so happens that the orbit of this November group cuts that of our earth, and the reason why we do not have this display every year in the months aforesaid, is, that the meteoric mass requires some 33¼ years to perform its revolution; so that we can only pass through the thickest part of it once in every 33 years.

INDEX

PAGE

Alcyone, Its Importance, ... 54
Alcyone, Distance of, ... 55
Almach, Double Star in Andromeda, ... 33
Algol, the Demon Star, ... 32
Altered Position of the Constellations, ... 17, 31
Altered Position of the Constellations in the Morning, ... 40
Alpheca, in the Crown, ... 29
Alcor, in the Plough Handle, ... 19
Altair, in the Eagle, ... 27
Andromeda, Constellation of, ... 32
Antares, the Red Star in *Scorpio*, ... 76, 109
Anaxagoras, his Opinion of the Heavenly Bodies, ... 74
April, The Constellations in, ... 70, 71
Aquila, the Eagle, ... 27
Arcturus, in Boötes, ... 29, 66
Argo, the Ship, ... 67
Arided or Deneb, in Cygnus, ... 38
Astronomy of the Ancients, ... 68, 72
Astronomical Notions of the Ancients, ... 74, 75
Asteroids, The—or Planetoids, ... 97
Attic-Window Astronomy, ... 31
Auriga, the Waggoner, ... 12, 28

Bessel and the Star 61 Cygni, ... 37
Bernice's Hair, Coma Bernices, ... 58
Betelgeux, or Betelgeuse, in Orion, ... 50
Biela's Comet, ... 117
Boötes, The Constellation of, ... 29

Capella, in Auriga, ... 28
Cassiopeia, The Constellation of, ... 22, 24
Cassiopeia, New Star in, ... 22
Cameleopardalis, The Constellation of, ... 24
Cancer, the Crab, ... 42
Castor and Pollux in Gemini, ... 42, 59
Cetus, the Whale, Constellation of, ... 36
Cepheus, ... 24
Cicero on the Plan of the Universe, ... 68
Coloured Stars, ... 33, 34
Cor Caroli, in Canes Venatici, ... 58
Constellations, Apparent shifting of, ... 58, 59, 65
Constellations, their positions at different hours, ... 58

PAGE
Constellations of the Zodiac, ... 40, 41, 42
Constellations of the Southern Hemisphere, ... 110
Constellations of the Northern Hemisphere, ... 112
Constellations connected with the Deluge, ... 67
Constellations, their positions in May, ... 76
Cor Hydrae, the Heart of the Great Sea-Serpent, ... 67
Copernicus, his System, ... 72
Copernicus, his Theory anticipated, ... 69
Comets, Phenomena of, ... 115
Comets, their Chemical Constitution, ... 118
Cygnus, the Swan, Constellation of, ... 27, 38

Distance, Immense, of the Stars, ... 13
Double Stars, ... 19, 33, 34
Dog-Star, in Canis Major, ... 59, 50
Dog-Days, Dies Canicularis, ... 60
Donnati's Comet, ... 116
Dream of the German Poet, ... 63
Draco—the Dragon, Constellation of, ... 23, 24

Earth, Chemical Constitution of the, ... 87, 88
Earth—Old Age and Death, ... 105
Earth, its Age estimated, and Dimensions, ... 85
Earth, its Rate of Motion and Distance from the Sun, ... 86, 87
Earth, Our, as seen from the other Planets, ... 85, 86
Ecliptic, Plane of the, ... 31
Equinoctial Points, ... 33
Equinox, Precession of the, ... 44
Equatorial Constellations, ... 40
Equator, Celestial, ... 50
Eridanus, The River, ... 66

February, The Constellations in, ... 56
Fomalhaut in the Southern Fish, ... 109

Galileo, his Discoveries and Persecutions, ... 73, 74
Gemini, the Twins, ... 42
"Golden Age," Extract from, ... 107
Great Central Sun, ... 54
Grand Star-picture of the Year, ... 50, 51, 59
Grand Meteoric Tempest, ... 118, 119

Halloween, a Pleiadic Festival, ... 53
Hercules, The Constellation of, ... 80
Hindoo Origin of the Names of the Constellations, ... 35
Hyades, in the Head of the Bull, ... 47

Indians, Iroquois, ... 18

January, Constellations in, ... 48, 49

PAGE
Jupiter, The Planet, ... 98, 99, 100

King's Ell, or Ell-wand, ... 50

Leo, the Lion, ... 42, 57
L. E. L. on the Pole-Star, ... 21
Light, Velocity of, ... 13, 37
Libra, the Balance, ... 42, 109
Lists of Stars and Constellations, ... 110
Lyra, The Constellation of, ... 26, 28

Mars, ... 95, 96, 97
March, The Constellations in, ... 64, 67
Medusa, Head of the, ... 33
Mercury, The Planet, ... 92, 93, 94
Meteors, ... 102, 117
Meridian, Line of the, ... 33
Milky-Way—Absurd Opinions of the Ancients, ... 27, 44
Mizar, Double Star in the Plough, ... 19
Mira, or the Wonderful Star, ... 56, 57
Moon, The, its Changes, Condition, and other Phenomena, 88, 91
Moon, The, her Dimensions, Distance, &c., ... 114

New Stars, ... 22, 29, 38
Nebulæ, their Nature and Numbers, ... 62, 63
Nebula, The Great, of Orion, ... 63
Nebular Theory, ... 38, 39, 78, 84
Nebula-Ring in Lyra, ... 26
Neptune, The Planet, ... 102
November Meteors, ... 118
November, The Constellations in, ... 31, 32

Orbit, Extent of the Earth's, ... 18
Orbit, Diameter of the, ... 114
Orion, The Constellation of, ... 50, 61
Orion, Ocultation of, ... 61
Orion, Great Nebula of, ... 62
Origin of the November Meteoric Showers, ... 118

Paralax, Measuring by, ... 36, 37
Perseus, The Constellation of, ... 32
Pegasus, or the Winged Horse, Constellation of, ... 32
Pisces, the Fishes, ... 42
Plough, or the Great Bear, ... 18
Pleiades, The, or Seven Sisters, ... 46, 51, 52
Pleiadic Festivals, ... 51, 52, 53
Planets, The—Are they Inhabited? ... 84
Planets, The larger, their Dimensions, Distances, &c., ... 114
Polaris, or the Pole-star, ... 16
Polar Points, Shifting of the, ... 21

PAGE
Quadruple Stars, ... 26

Regulus, in Leo, ... 57
Rigel, in Orion, ... 50
Sagittarius, ... 42
Saturn, The Planet, ... 100, 101
Scorpio, the Scorpion, ... 42, 109
Seasons, Change of, how caused, ... 86, 87
Shooting Stars, ... 117
Sirius, in Canis Major, ... 59, 60
Solar System, Chart of the, ... 77
Starry Sphere, Real or Apparent Revolutions of, ... 17
Stars, their probable Decay and Death, ... 104
Stars of the First Magnitude, List of, ... 118
Stars, Distances of the Nearest, ... 114
Stars, Chemical constitution of, ... 104
Sun, The Dimensions of, ... 79, 114
Sun Spots, their Nature and Extent, ... 79, 80
Sun, The, a Variable Star, ... 80
Sun, Chemical constitution of the, ... 81, 88
Sun, Light and Heat of the, ... 82
Sun-storms and Sun-force, ... 82, 88
Swan, Constellation of the, ... 27, 38
Swan, New Star in, ... 38

Taurus, the Bull, Constellation of, ... 46
Twins, The, ... 42

Universe, The Spiritual, ... 106
Ursa Major, or the Great Bear, ... 18, 20
Ursa Minor, or the Little Bear, ... 16
Uranus, The Planet, ... 102

Variable Stars, ... 82, 83
Vega, in the Constellation of Lyra, ... 23, 26
Venus, The Planet, ... 94, 95
Virgo, The Virgin, ... 42, 66

Wilson, Dr., of Glasgow, on Sun-spots, ... 79

Xenophanes, his opinion of the Stars, ... 74

Zodiac, Signs of the, ... 41
Zodiac, Constellations of the, ... 40, 41, 42
Zodiac, Scriptural allusions to the, ... 44, 45
Zodiac, Chinese names for the Constellations of the, ... 43, 46
Zodiac, Origin of the Signs of the, ... 43
Zodiac, Priestly attempt to change the names of the Signs, 73
Zodiac, List of Constellations in the, ... 113

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Few among our minor Scottish singers "warble their native wood-notes wild" more musically than James Nicholson of Strathaven. Of the Poems embraced in the collection to which Mr. Nicholson and his daughter have jointly contributed, a number have already taken the place which they thoroughly deserve to occupy in the affections of the public, and the lyrics that see the light for the first time will not be the less welcome because they are accompanied by these old favourites. The warm love of nature, the delicacy and often the elevation of feeling, and the manly spirit that breathes in these verses, would entitle them to notice even were they clothed in a rough homely garb. But in most of them we find, also, a grace, a refinement, and an aptness of expression, which the author's humble origin and scanty opportunities of study would scarcely lead us to expect. "The Herd Laddie,"—the longest poem in the collection—"Auld Barnock," "The Burnie," "Mosses in Winter," and "Little February," are examples of his close and sympathetic study of nature, and his success in interpreting its moods; while of "fireside lyrics," blending tenderness and humour, few better specimens could be given than the "Auld Farrant Wean," the "Dautit Wee Wean," the "Cosy Bit Hame," "Oor Wee Kate," and perhaps best of all, "Jenny wi' the Lang Pock." Broader in their effects are such pieces as the "Cauld East Wind," "Im-hm," and the capital sketches entitled, "The Gaiters," and the "First Soiree;" but, at its broadest, Mr. Nicholson's humour never degenerates into vulgarity. Miss Nicholson, the original, apparently, of the "Auld Farrant Wean," has inherited no small portion of her father's lyrical talent, and "Wee

Feetikins," for example, is not excelled in pathos by anything in the book.—*Scotsman.*

Poets have handed on their powers to their daughters. "Barry Cornwall" had the delight of reading the verses of Adelaide Proctor with all a father's pride; but the poet and the poetess never united in sending forth to the world a volume of their joint composition, as Mr. and Miss Nicholson have lately done. The father, we believe, has already attained some poetic reputation, and has, at any rate, succeeded in winning praise and congratulation from his fellow-countryman, Thomas Carlyle. Indeed, many of his poems dealing with Scotch life and character are admirable, and full of quiet but effective fun. There is one capital poem on the well-known Scotch "Im-hm," which has perplexed, amused, and irritated many a "Saxon"; and "Wee Kate" and the "Gaiters" are nearly as good. Mr. Nicholson seems to be a botanist, too; and elsewhere, in some graceful and pretty verses, he gives us a most pleasant description of favourite wild flowers. But the father will readily forgive us if, somewhat neglecting his poems, we at once pass to those of his daughter; to whom, in some pathetic lines, he resigns his gift of song. She has, in some of her simpler pieces, such as "Baby Marion," been most successful; but as yet she seems hardly to have discovered her true themes. One faculty, too often denied to women, is hers—a true sense of humour, which makes itself felt more than once in her verses, and especially in the last stanza of "The Artist's Pet Picture."—*Literary World.*

Miss Nicholson, while showing herself less intimate with the nature of the hillside, the burnbank, and the dell, seems more familiar with sea-coast scenery, and possessed of a stronger bent for metaphysical dissection. Her verse is more evenly balanced, and is far freer of incidental defects, while the genius bequeathed seems, when at its highest, not below the best mark of her father.—*Shields Daily Standard.*

The characteristics of James Nicholson's poetry are a certain homely shrewdness, expressed often in the happiest Scotch, a disposition to look on the bright or the humorous side of things, descriptive power of no mean order. These qualities, coupled with that nameless charm which every now and then lights up a line or turns a period and makes the reader feel that here are singers who have something to say, and who can say it, combine to make this little book a treasure. There is nothing finer in all the literature of childhood than "Jenny wi' the Lang Pock," and it is not an exceptional specimen of James Nicholson's power.—*Shields Daily Gazette.*

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James Nicholson is one of those few poets from whose lips the Doric flows with much of the sweetness, and a great deal of the force, which characterised the language in the days of Burns.—*Elgin and Morayshire Courier.*

Pawkie humour, that quality so largely developed in the Scottish character, and particularly so in the genuine Scottish minstrel, is possessed in no stinted measure by Nicholson.—*Ayrshire Express.*

In the lowliness of his birth, in the struggles and disadvantages of his youth, in the persevering and independent spirit with which he overcame all adverse circumstances, and in the excellent use he has made of his opportunities and talents, James Nicholson is entitled to be henceforth honourably named with the Nichols, the Bethunes, and other humble sons of genius of whom Scotland has such just reason to be proud.—*Scotsman.*

The touch of genius is upon every page of this little book ["Father Fernie"]. It is difficult to say whether the charm of the story, the poems, or the botanical conversations, is the greatest. James Nicholson is one of the peasant poets of Scotland, entitled to sing with the best of her minor minstrels. An exquisite fancy, a rich imagination, a quaint humour, and a tenderness as manly as it is touching, give a magic to his pen. It is not often that elementary science is clothed in such an attractive garb.—*British Quarterly.*

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